Electrical Review

WITH WHICH IS CONSOLIDATED WESTERN ELECTRICIAN AND ELECTROCRAFT.

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Fig. 1.—America's First Hydroelectric Plant. Niagara Falls. Started in 1895 and Still in Operation.

Development of Hydroelectric Resources in Eastern United States

Deterring Influences and Development are Outlined—Brief Review of What Has Already Been Accomplished—Urgent Need and Benefits of Hydroelectric Developments Given

By D. H. COLCORD

Westinghouse Electric & Manufacturing Co.

IN THE United States today there are approximately four or five times as much steam as water horsepower in use. The aggregate water horsepower developed and undeveloped is around 60,000,000. The Secretary of Agriculture estimates the water power development in 1916 to be 6,500,000. This means that there is still undeveloped water power in this country equal to twice the present steam capacity in service. Approximately 40,000,000 of the undeveloped water-power is in thirteen of the Western States, leaving about 13,500,000 in the East.

It is with the possibilities of developing these 13,500,000 horsepower in Eastern United States that this discussion deals. As 32,500,000 horsepower is generated by steam and as this steam is generally created from coal—a fuel which is sometime going to be exhausted—and as the greater proportion of steam power is used in the East, where there is always a market for power, the question of numerous small developments here although less romantic than harnessing the tremendous water power potentialities in the Rockies, has certain concrete financial possibilities.

Certain economic and legislative factors have taught the uninitiated investor in hydroelectric enter-

prises several costly lessons in recent years, and it seems worth while to review these considerations before pointing out waterpower advantages.

1. Load-factors have been overestimated.
2. Drought in summer and ice in winter have prevented the constant source of power counted on to supply the consumer. The initial cost for building impounding dams to overcome this difficulty was so great that although companies might have succeeded in the long run, they could not compete with steam power companies, during their infancy.
3. The high cost of transmission systems in a mountainous country has been prohibitive in some degree.
4. The cost of installation is high. In 1914, the total cost of installing hydroelectric plants was estimated at $27,000,000 including distribution systems and auxiliary equipment. This gives an average cost per horsepower of $158. A general estimate of the cost complete as given by a prominent engineering company, not including distribution or step-down transformers has ranged from $75 to $150 per kilowatt installed. If the price of coal increases, in time it will compare favorably. At least the marginal difference in cost will demand increased efficiency in the operation of hydroelectric plants which might make up for this difference. The best steam practice secures at the electric generator less than 20% of the energy stored in coal, while the efficiency of the water wheel frequently exceeds 90% which is worth considering.
5. The rapid development of the steam turbine with its increased efficiency has discouraged water power.
6. The distance because of the mountainous nature of the East, from the market, has been a factor.
7. The high value of land in industrial districts has restricted development.
8. Railroads have followed the streams and in many instances would have to be rebuilt.
9. Many of the streams are of an interstate character involving legislative difficulties.
10. The fact that several projects have been started and abandoned has had a bad moral influence.
11. Long-term franchises held by municipal heating and lighting companies made competition impossible.
12. The forestry laws contain inadequate provisions for the leasing of land.
13. There is a scarcity of real good-head sites.
14. There is not enough data available on the geological features of stream beds.
15. The recent scarcity and high cost of labor and building material has prevented, since the war, even the completion of developments already started.

The report of the Pennsylvania Water Commission of 1916, contains data on hydroelectric projects that have been started and dropped for various reasons:

1. These projects were begun at a time when there was a marked scarcity of capital in this country.
2. The companies failed to realize the necessity for a complete engineering survey and improper sites were chosen and then abandoned.
3. Hydrographic conditions were overestimated and in some cases there was not as much water available as counted on.
4. Commercial surveys were not thorough in all cases and companies in some cases overestimated their markets for power.
5. In three instances uncertainty in regard to the legal rights possessed by the companies, and subsequent legislation blocked their progress.
6. In several projects, the blame for failure can be laid at the door of financial misfortune.

Fig. 2.—Power House of Pennsylvania Water and Power Company at Holtwood, Pa.

To attempt to present in so limited a space even a general summary of what has already been accomplished in developing waterpower facilities in the East would be a task of doubtful value. The wide difference in the capacity of completed plants, some producing as small an amount as 8 horsepower, would indicate little but a brief account of the completed developments in Pennsylvania are indicative of conditions in general.

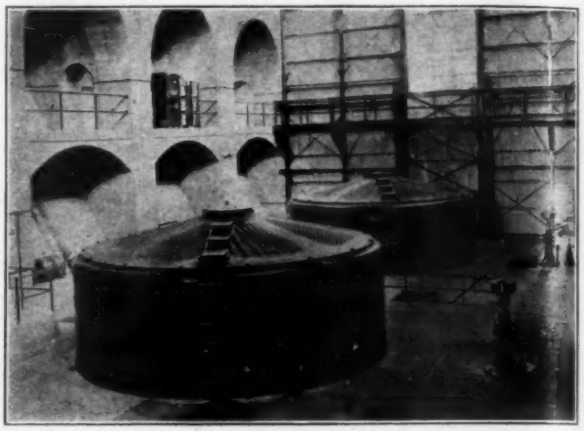


Fig. 3.—Two 12,000kv-a., 25-cycle, 11,000-volt, Vertical Waterwheel Generators in Holdwood Station.

The grand total of all hydroelectric plants in Pennsylvania in 1916, 61 in number, including auxiliary power units, was 172,872 horsepower. These plants vary from 8 horsepower to the capacity of the largest central station at Holtwood. The Holtwood plant is located on the Susquehanna River and is laid out for ten vertical units. Eight units have now been installed. The dam is half a mile in length, built of solid concrete with an average height of 55 ft. The power generated at 11,000 volts is stepped up through three-phase transformers to 70,000 volts, and is transmitted about 40 miles to the city of Baltimore over aluminum cables suspended from steel towers. The development is owned by the Pennsylvania Water and Power Co.

The following table is taken from a report of the New Jersey Water Commission for 1918 and compares the utilization of water power along the Musconetcong river between Hackettstown and Riegelsville for 1894 and 1918. Excepting the Passaic river, the Musconetcong has the greatest hydroelectric facilities in the state.

	1894		1918	
Kind of Mill.	Hp.	No. of Mills.	Hp.	No. of Mills.
Paper mills	955	3	1 610	3
Grist mills	579	10	368	6
Graphite grinding mills	80	1	290	2
Worsted yarn mills	...	..	110	1
Machine knives mills	75	1	100	1
Saw mills	...	..	40	1
Snuff mills	35	1	...	..
Total	1,724	16	2,518	14
Total head in feet.	179		176	

The table shows an increase of 46% in total horsepower in 24 years, although the number of mills decreased by two. It proves that hydroelectric power is successful even within easy hauling distance of the coal mines, and means that a similar outlay on other developed streams would not be a mere venture.

The general advantages desired from a greater development are:

1. The highest use of coal is to create heat to preserve man's life and the term of man's existence may depend on the care of the supply. Fuel is not essentially reproductive. Waterpower for industry can save the nation millions of tons of coal a year.
2. The East is first and foremost an industrial section and depends primarily on fuel and any effort to conserve it will lengthen out productive life.
3. The electrification of all railroads in the United States is inevitable and provision must be made to supply the electric power. As railroads follow the streams the natural source of power is that which is the most available—the stream itself.
4. Waterpower makes electric lighting possible wherever it is needed.
5. Where steam power is already used it can well be supplemented by water power.
6. Storage reservoirs used with hydroelectric plants are a protection against floods.
7. During the droughts in summer, the expulsion of water from impounding dams improves sanitary conditions along the stream below.
8. Impounding dams on rivers often improves navigation.
9. The thickly-settled districts afford a large market for electric power with reasonable transmission distances.
10. The prevalence of old canals and dam sites make it possible to install a plant at a small cost.
11. There are many limestone streams in the mountainous districts that have a high rate of flow during the dry seasons.
12. Labor released by the close of the war, can be used to build the plants.
13. Increased industrial efficiency is effected due to labor saving and waste prevention in distributing power.

From a conservative and absolutely safe standpoint considering immediate returns on the investment, the correct policy here in the East is to use the waterpower only to supplement steam and where coal is available at a fair price. But this policy is somewhat pinched and near-sighted from national industrial and economic standpoints because the time is coming when the available coal will be gone. A nation like ours can afford to dream at least of the time when every river that runs from the summits of the Appalachian Mountains to the sea will halt from time to time in its wanton course and convert its energy into power that will electrify the Atlantic Seaboard. There may come a time when the coal that is left will be required for purposes that a central station cannot serve such as driving the engines on our ocean liners or as fuel for keeping us warm.

In Eastern United States, hydroelectric possibilities, still vague and indefinite, are tremendous, colossal. Horsepower that runs into millions is being wasted every year as our rivers run wantonly to the sea. Why is it not possible for the Genesee, the Delaware, Susquehanna, the Juniata, Allegheny, Monongahela, Ohio, the Passaic or the Musconetcong rivers to be harnessed as completely as has the Huron, the Kalamazoo or the Grand Rivers of Michigan? For example, imagine central stations at Lock Haven, Williamsport, Harrisburg, Sunbury, each the size of the complete hydroelectric plant at Manistee, Michigan. They would furnish power for twenty cities and towns, turning the wheels for great silk and paper mills and make it possible to electrify the whole Buffalo-Washington Division of the Pennsylvania Railroad. Multiply this river by hundreds of other streams, and these cities by thousands of other cities, and the vision appears of a vast network of transmission systems extending from Maine to Florida furnishing every unit of power required for anything from that of preparing the toast for breakfast to that of driving giant locomotives over the Allegheny Mountains. The vision contracts considerably, when you consider that Pittsburgh in 1914 had only 2320 horsepower derived from water turbines in the Ohio basin.

Fig. 4.—Interior of Power Plant at Augusta, Ga., Contains Five 2700 kv-a. 2300-volt Vertical Generators.

General View of Cement Plant of Southwestern Portland Cement Co., El Paso, Texas.

Operating Details of an Electrically Operated Cement Mill

Progress of Material Through Mill—Process of Cement Manufacture—Apparatus and Size of Motors Utilized

THE Southwestern Portland Cement Co.'s plant at El Paso, Tex., is ideally located geographically in the center of a thriving market, furnishing the greater portion of the cement used in Western Texas, southern Arizona and New Mexico. The plant is located on a bank of the Rio Grande river, about 3½ miles from the center of El Paso, Texas, and has a capacity of 1500 barrels per day of 24 hours. The company owns 905 acres adjacent, practically all of which is cement material. The plant is constructed throughout of reinforced concrete, about 17,000 bbl. of cement being used. The buildings are in the natural color and present a substantial and pleasing effect.

Handling Raw Materials.

The materials used are limestone and shale, the quarry being located about 1800 ft. up the river from the plant. The two materials, in a deposit averaging about 75 ft. in depth, lie side by side. Blast holes of 5⅝ in. are drilled with a well-drill driven by a gasoline engine, the holes being set back from the face 25 to 30 ft. and about the same distance on centers and are drilled from the top to a depth of a few feet below the quarry floor. A number of these holes are shot at a time and from 30,000 to 40,000 tons of material are broken down with one blast. The rock is then loaded by hand into 3-yard side-dump cars, furnished by the Continental Car and Equipment Co., that are hauled to the crushing department by a 25-ton Davenport locomotive, in trains of 10 to 15 cars each.

The train of material, when arriving at the crushing department, is run up an incline and the cars are dumped into two large concrete hoppers over two No. 6 Allis-Chalmers Co.'s gyratory crushers which crush the material to a fineness that all will pass about 2½-in. ring. It is then elevated and passed through two 36 by 16-in. corrugated face Buchanan rolls which reduces the material so that all will pass a 1-in. ring. The rolls deliver the crushed material to a 24 by 24-in. Webster pivot bucket carrier; thence it is elevated, conveyed and delivered into the crushed rock bins.

Crushed Rock Bins.

The crushed rock bins, six in number, are 23 ft. inside diameter by 32 ft. deep with a 50-in. hopper bottom and have a capacity of 600 tons each. There are four cast-iron hoppers in each bin equipped with a valve by which the material can be drawn out and delivered into the pivot bucket carrier and carried back into the proportion department. With this arrangement the pivot bucket carrier completely girts the rolls and crushed rock bins, passing over the top of the latter and returning through a tunnel underneath. The carrier coming up from the rolls loaded with crushed material, delivers into any one of the crushed rock bins. The lower run is then used for conveying the material from these bins to an elevator which delivers the material to one of the proportion bins. At this point about 10% slag is added to the mixture, the material passing through Richardson Scale Co.'s automatic scales, the slag being secured from the slag dump of the El Paso smelter, adjacent to the factory. The material, after passing through the automatic scales, is now what is termed "the mix" and is elevated and delivered to a 24-in. belt conveyor fitted with an automatic self propelling tripper, delivering the mix to the blending bins. After being delivered from the elevator the mix passes through an automatic sampler, which cuts out a sample equal to .01 of 1%. The sample is then run through a small mill furnished by the Williams Patent Crusher and Pulverizer Co., and is reduced to a fineness that will pass a No. 8 screen. From this sample the chemist makes his analysis and determines the ratio of silica, alumina and lime in the mix as it is delivered to the various blending bins.

Blending Bins and Dryer.

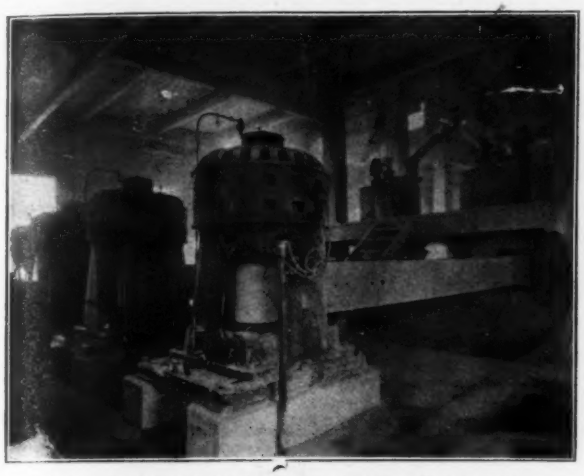
The blending bins, six in number, are an exact duplicate of the crushed rock bins heretofore described. The mix is now drawn from the blending bins on to a belt conveyor which delivers the material into an elevator which in turn delivers into a bin over the dryer. By drawing from one or more blending bins at the same time the mix can be corrected if necessary, the chemist having a record of the analysis of the mix as it was delivered to them.

The mix is now fed by an automatic feeder to a rotary dryer 6 ft. in diameter and 100 ft. long which is hand-fired with coal. After passing through the dryer, the mix is raised to a temperature of about 250° F. and is then discharged into a screw conveyor for delivery to the raw grinding department.

The screw conveyor brings the material from the

dryer, and delivers to an elevator, which conveys it to four bins over eight 42-in. Fuller mills. The product from these mills, ground to a fineness that about 95% will pass 100 mesh and 84% will pass a 200 mesh sieve, is elevated, conveyed and delivered to a blending silo.

The blending silo is composed of ten bins, 15 ft. square inside by 39 ft. deep with 50-in. hopper bottom, each bin being fitted with a screw feeder which auto-



90 Hp. Vertical Belted Motors Driving Fuller Mills.

matically draws the mix and delivers it into a mixing conveyor directly underneath. All the material coming from the raw grinding department is delivered into, say—No. 1 silo bin, for a period of two hours, then into No. 2 silo bin and so on until a complete cycle of the ten bins has been made. The above operation is then repeated.

The ten feeders under the silo bins are operated at the same time, their combined capacity being 25% in excess of that required to supply the kilns operating at full capacity. This material after being thoroughly mixed, is elevated and conveyed to the feed bins in the kiln department, the 25% excess being delivered into the conveyor, bringing the material from the raw grinding department, and is returned to the silo.

Kilns.

The material is drawn from the kiln feed bin by a motor-driven screw feeder controlled from the burning end of the kiln. There are two 8 by 150-ft. kilns driven by variable-speed motors. Pulverized coal is used for fuel and is fed into the kiln by small motor-driven screw feeders. Two Sirocco blowers supply the air for blowing the pulverized coal into the kiln. The kilns deliver the clinker direct into 6 by 60-ft. rotary coolers, one for each kiln, the coolers delivering the cool clinker into automatic scales which dump directly into an elevator for delivery into the clinker storage bins.

Clinker Storage.

The clinker storage bins, six in number, are practically duplicates of the crushed rock and blending bins, the clinker from the clinker storage bins being handled by 24 by 24-in. pivot bucket carrier which completely girts the bins and passes over the Verbund mill bin in the cement grinding department. With this arrangement the carrier can be used for handling the clinker from any one of the storage bins and delivered into any other bin or on the ground. About 25% of the clinker stored on the ground can be spouted back into the carrier, the remainder being handled by a traveling locomotive crane equipped with a 1½-cu. yd. grab bucket. The crane can pick up the clinker and deliver it through a spout into the carrier in the tunnel, thence it goes into the cement grinding department or back into the clinker storage bins. This arrangement provides unlimited storage. The pivot bucket carrier in passing to the cement grinding department travels over a Merrick weightometer (with a recording instrument in the cement grinding department), which registers each 1000 lb. of clinker carried. Each time the instrument records 1000 lb. about 3% of gypsum is added to the clinker.

Cement Grinding.

The clinker coming from the clinker storage department is dumped into a bin over an Allis-Chalmers No. 722 Verbund mill, driven by a 400-hp. motor connected direct to the mill by Wuest gear, the reduction between the motor and the mill being 18 to 1. The mill has chilled iron linings and carries a charge of 85,000 lb. of metallic balls in two compartments. The first compartment, or preliminary end of the mill, is charged with forged steel balls ranging in size from 2 to 5 in. in diameter; the second with ⅞-in. diameter chilled iron balls. The mill taking clinker direct from storage has a capacity of 70 barrels per hour, consuming about 350 b.hp. The finished cement from the Verbund mill is spouted direct to an elevator and is elevated, conveyed and distributed to the cement storage department.

Cement Storage.

The cement storage department consists of 15 bins, 23 ft. inside diameter in three rows of 5 bins to the row. This also gives 8 small bins in between the large ones, giving a total capacity of 50,000 barrels. The center row bins are 42 ft. deep and the two outside rows 35 ft. deep. All of the bins with the exception of the small ones have 50-in. hopper bottoms with four cast-iron hoppers each, through

Group Control of Induction Motors.

which the finished cement can be drawn and delivered to a screw conveyor in the tunnel under each row of bins. The three screw conveyors discharge into an elevator, and the cement is delivered into a revolving screen which takes out all foreign matter, such as

bolts, sticks of wood, etc., which from time to time find their way into the finished cement.

From the screen the cement is distributed into bins over three Bates bagging machines. These machines automatically fill the sacks to the exact weight of 95 lb. each, four sacks making one barrel of cement, which is the unit used for calculating capacities, costs, etc., in all departments. The bagging machines after filling the sacks to the required weight automatically drop them on to a belt conveyor which carries the filled sacks to the car door, from which point they are tucked into the cars by hand. A 15-hp. motor is direct connected to each bagging machine. The sacks are tied with a wire before they are delivered to the bagging machines and are filled through a valve opening in the bottom of the sacks. The above described departments are what are termed the producing departments. The non-producing departments are the coal grinding department, which pulverizes coal for firing the kilns, and the power department which produces the necessary electrical energy for operating the motors and lights in the plant.

The coal grinding department is arranged to take either run-of-mine or slack coal which can be handled from box cars, gondolas or hopper bottom cars. There are two unloading stations. Under one is a plain hopper with a valve through which the coal can be dumped or shoveled from the car. Under the other hopper is a Jeffery coal crusher, having a capacity of 25 to 30 tons run-of-mine coal per hour, reducing same so that all will pass a 2½-in. ring. A 24 by 24-in. pivot bucket carrier passes directly under the roll and the slack coal hopper, rises vertically and passes over and through the coal grinding department and over the coal storage bin, returning through a tunnel underneath, making a complete circuit. The carrier will handle 40 to 50 tons of coal per hour and deliver it either in the bin over the coal dryer or the coal storage bin. The coal from the storage bin can be drawn out through the bottom into the carrier and delivered either into the dryer bin or again dumped into the coal storage bin. There are four coal storage bins which are duplicates of the crushed rock blending bins having a capacity of 300 tons of slack coal each. In the coal grinding department there are one Cummer coal dryer and two 42-in. Fuller mills. The coal as fed to the dryer passes through an automatic scale, which records the amount of coal ground and delivered to the kiln department.

Power Department.

In the power department are two 750 kv-a., 440-volt, 60-cycle, 3-phase, Westinghouse turbogenerators operating on 200 lb. steam and 100° superheat. Both units are served by a Westinghouse surface condenser, the circulating water being cooled in a reservoir adjacent to the power house by the Spray cooling system. There are two exciter units, one driven by a Westinghouse high-speed vertical engine and the other by an alternating-current motor, the steam unit being used for starting only. A 500-cu. ft. Ingersoll Rand air compressor driven by a 100-hp. motor supplies air at 80 lb. pressure for rock drills in the quarry and general use about the plant. The switchboard consists of one panel each for the turbogenerators, exciter sets and each department in the plant, also one lighting panel. The generators are hooked up solid to the busbars on the switchboard but each of the distributing panels is equipped with overload automatic oil switches. The current is delivered to the various departments in the plant by lead-covered cables in fiber conduit laid in concrete. In the boiler room are four 400-hp. Stirling boilers equipped with superheaters and Green traveling chain-grate stokers. The feed water is run through a closed heater and through Green fuel economizers installed in a concrete breeching directly behind the boilers. Draft is supplied by an 8 by 200-ft. reinforced concrete chimney. Induced mechanical draft is also installed for use when the plant is required to carry an over-load. Slack coal is used for fuel and is dumped directly from the cars into a pivot bucket carrier which delivers it into coal pockets over the boilers, each coal pocket having a capacity of 150 tons. The pivot bucket carrier also handles the ashes which are delivered into a bin over the track from which they can be either spouted into a car or into wagons, as desired.

Interior of Turbine Room, Showing Turbogenerators, Exciters and Switchboard.

Water System.

The water supply is derived from a plant about 1½ miles above the factory on the river. A dam was constructed across the arroyo, forming a reservoir, having a capacity of 97,000,000 gallons. The pumping house is on a rocky promotory on the bank of the Rio Grande where a motor-driven turbine pump having a capacity of 2200 g.p.m. is installed. The pump delivers the water directly to the reservoir through a 10-in. pipe line. The pumping is done during what is called a "pumping condition":—the water is analysed daily and when the total solids fall below 25 grains per U. S. gallon the water is pumped. The pump is driven by a 2200-volt motor. A high-tension line from the power house delivers the current to the motor after passing through step-up transformers. From the reservoir the water is taken through a concrete tower, passed through a wier-box so that the flow may be gauged and piped to the plant through an 8-in. pipe, and is delivered into the concrete reservoir in which the Spray cooling system is located.

The plant is motor-driven throughout with 60-cycle, 3-phase, 440-volt induction motors ranging from 10 to 440 hp. All machines are motor driven with the exception of a few conveyors and elevators, which when the arrangement would permit, are group driven from a counter-shaft. The Westinghouse Electric and Manufacturing Co. furnished the motor equipment; the Vulcan Iron Works, the kilns, dryers and coolers; Webster Manufacturing Co., the pivot bucket carriers and elevators; H. W. Caldwell & Sons Co., the conveyors.

Power and Torque in Electric Motors

Last of a Series of Articles Discussing the Principles of Different Types of Motors From a Common Standpoint—Relations in Single-Phase Induction and Repulsion Motors

By JUSTIN LEBOVICI

Lack of clear understanding of the action of alternating-current motors is due largely to failure to consider their principles on a basis applicable to all classes of motors. In these articles Mr. Lebovici presents a discussion of power and torque of different kinds of motors based on the principles of the direct-current motor and of the static transformer. The fundamentals were reviewed in the first four installments and applied to the direct-current, polyphase and single-phase induction motors. This last article concludes discussion of the single-phase induction type. These articles should be read in connection with the author's two series of articles on alternating-current motors and their windings published in our issues during 1916.

IN THE preceding (fourth) article of this series we took up consideration of the single-phase induction motor. We reviewed the general relations existing in this motor while running and discussed the starting and running torques. Below we will first continue our study of this type of motor and then take up the so-called repulsion type.

(d) Analytical Derivation of the Equation for the Current in a Single-Phase Induction Motor.

Through the pulsation of the flux of mutual induction ϕ_1 in the stator axis YY we induce an emf. E_{3p}. In the same axis the pulsation of leakage flux ϕ_{11} due to the load current I_3 produces the emf. I_3x_3. The total emf. due to pulsation in the YY axis is

$$E_{3p} - jI_3x_3 \quad \ldots\ldots (82)$$

Through rotation in the flux ϕ_1 and ϕ_{11} is generated the emf.

$$-j\frac{f_r}{f}\left(E_{3p} - jI_3x_3\right) \quad \ldots\ldots (83)$$

which has to balance the emf. E_{2p} due to pulsation of flux ϕ_4,

also $I_{m4}r_2$ and $jI_{m4}x_2$.

Calling, same as before Z_a the exciting impedance, we can write

$$E_{2p} = I_{m4}Z_a \quad \ldots\ldots (84)$$

The following relation holds good for the axis XX in Fig. 43.

$$-j\frac{f_r}{f}\left(E_{3p} - jI_3x_3\right) = I_{m4}\left(Z_a + r_2 + jx_2\right) \quad \ldots\ldots (85)$$

In the stator axis YY the emf. E_{3p} has to balance the emf. E_{3r} due to the rotation of the conductors in the flux ϕ_4 and ϕ_{41}, also I_3r_2 and I_3x_2. We therefore have

$$-E_{3r} = -j\frac{f_r}{f}I_{m4}\left(Z_a + jx_2\right) \quad \ldots\ldots (86)$$

and we can write for the YY axis in Fig. 43

$$E_{3p} - E_{3r} = E_{3p} - j\frac{f_r}{f}I_{m4}(Z_a + jx_2) = I_3(r_2 + jx_2) \quad \ldots (87)$$

but $$-j\frac{f_r}{f}I_{m4}(Z_a + jx_2) = -\left(\frac{f_r}{f}\right)^2\left[E_{3p} - jI_3x_3\right] + j\frac{f_r}{f}I_{m4}r_2 \quad \ldots (88)$$

substituting in (87) the equation (85) we have

$$E_{3p} - \left(\frac{f_r}{f}\right)^2 E_{3p} = -jI_3x_2\left(\frac{f_r}{f}\right)^2 - j\left(\frac{f_r}{f}\right)I_{m4}r_2 + I_3(r_2 + jx_2) \quad \ldots (89)$$

or $$E_{3p}\left[1 - \left(\frac{f_r}{f}\right)^2\right] = I_3\left\{r_2 + jx_2\left[1 - \left(\frac{f_r}{f}\right)^2\right]\right\} - j\frac{f_r}{f}I_{m4}r_2 \quad \ldots (90)$$

Multiplying all secondary quantities by the ratio of transformation and using the same equations (35) to (40) that we used when treating the polyphase motor, we can write equation (90) as follows:

$$E_1\left[1 - \left(\frac{f_r}{f}\right)^2\right] = I'_3\left\{r'_2 + jx'_2\left[1 - \left(\frac{f_r}{f}\right)^2\right]\right\} - j\frac{f_r}{f}I'_{m4}r'_2 \quad \ldots (91)$$

and, neglecting the factor due to the small magnetizing current, we obtain for the secondary load current

$$I'_3 = \frac{E_1\left[1 - \left(\frac{f_r}{f}\right)^2\right]}{r'_2 + jx'_2\left[1 - \left(\frac{f_r}{f}\right)^2\right]} = \frac{E_1}{\frac{r'_2}{1 - \left(\frac{f_r}{f}\right)^2} + jx'_2} \quad \ldots\ldots (92)$$

The current in the primary coil S_1 will be

$$I_1 = I_{m1} + I'_3 \quad \ldots\ldots (93)$$

and the primary voltage

$$V_1 = E_1 + I_1(r_1 + jx_1) \quad \ldots\ldots 94)$$

Transferring equation (92) from complex quantities to absolute values, we obtain for the secondary current the approximate value:

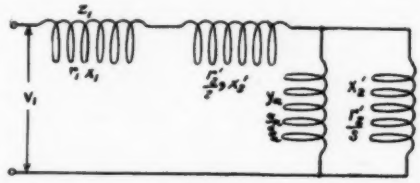


Fig. 55.

$$I'_3 = \frac{E_1}{\sqrt{\left[\frac{r'_2}{1 - \left(\frac{f_r}{f}\right)^2}\right]^2 + x'^2_2}} \quad \ldots\ldots (95)$$

(e) Power and Torque in Single-Phase Induction Motors.

The power input P_1 into the rotor, measured in watts, is given in the same way as previously, see equation (50), by the relation

$$P_1 = E_1I'_3\cos(E_1, I'_3) \quad \ldots\ldots (96)$$

but according to equation (95)

$$I'_3\cos(E_1, I'_3) = I'_3\frac{\frac{r'_2}{\left[1 - \left(\frac{f_r}{f}\right)^2\right]}}{\sqrt{\left(\frac{r'_2}{1 - \left(\frac{f_r}{f}\right)^2}\right)^2 + x'^2_2}} \quad \ldots\ldots (97)$$

and the power input into the rotor becomes by substituting (92) and (97) into (96)

$$P_1 = \frac{E_1^2 \dfrac{r'_2}{1-\left(\frac{f_r}{f}\right)^2}}{\left[\dfrac{r'_2}{1-\left(\frac{f_r}{f}\right)^2}\right]^2 + x'^2_2} \quad \ldots\ldots (98)$$

The rotor output P is given by subtracting from P_1 the rotor copper losses $I^1{}_2{}^2 r^1{}_2$ or

$$P = \frac{E_1^2\left[\dfrac{r'^2_2}{1-\left(\frac{f_r}{f}\right)^2} - r'_2\right]}{\left[\dfrac{r'_2}{1-\left(\frac{f_r}{f}\right)^2} + x'^2_2\right]} = \frac{E_1^2\left(\frac{f_r}{f}\right)^2 \dfrac{r'_2}{1-\left(\frac{f_r}{f}\right)^2}}{\left[\dfrac{r'_2}{1-\left(\frac{f_r}{f}\right)^2}\right]^2 + x'^2_2} \quad \ldots\ldots (99)$$

The rotor torque in watts is greater than P in proportion to f_r/f or

$$T_{syn} = \frac{E_1^2 \frac{f_r}{f} \dfrac{r'_2}{1-\left(\frac{f_r}{f}\right)^2}}{\left[\dfrac{r'_2}{1-\left(\frac{f_r}{f}\right)^2}\right]^2 + x'^2_2} = I'^2_2 \left(\frac{f_r}{f}\right) \frac{r'_2}{1-\left(\frac{f_r}{f}\right)^2} \quad \ldots\ldots (100)$$

Equation (100) is analogous to equation (58) derived in dealing with the polyphase motor except in place of the slip s we have the quantity

$$1 - (f_r/f)^2 \quad \ldots\ldots (101)$$

and we also note that the torque in synchronous watts

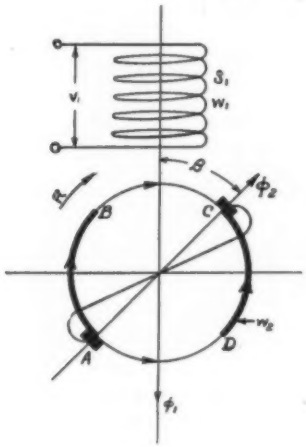


Fig. 56.

is (f_r/f) smaller than the synchronous torque per phase for the case of the polyphase motor.

(f) Pull-out Torque and Pull-out Output.

It has been shown before that the rotor leakage reactance $I_3 x_2$ along the stator or YY axis in Fig. 48 is duplicated, due to the rotation of the rotor conductors, by an emf. E_{2r1} along the exciting or XX axis. It has also been shown that the emf. is transferred to the transformer or stator axis and reflected in the primary winding. The rotor reactance appears twice and, if we want to apply formulas derived in connection with the polyphase motor, we will have to consider the single-phase motor as a polyphase machine with a reactance $(x_1 + x^1{}_2)$ in the stator winding.

The secondary current of a polyphase motor running free is practically nil, since the only losses to be covered are the friction and windage losses. On the other hand, the free-running single-phase induction motor has to cover, as has been shown, besides the friction and windage losses of the motor, the copper and iron losses along the exciting axis, as well as two negative torques. The rotor has to take a current along the transformer axis to cover the rotor losses and the negative torques and this current is reflected into the primary winding. Calling the no-load or free-running current of the single-phase induction motor I_{10}, the no-load copper losses are given by

$$I_{10}{}^2 r_1 + 2(I_{10}/2)^2 r^1{}_2 = I_{10}{}^2[r_1 + (r^1{}_2/2)] \quad \ldots (102)$$

Hence, in applying to single-phase induction motors formulas derived in connection with the polyphase motor, we will have to consider the single-phase motor as a polyphase machine with a

primary resistance $r_1 + (r^1{}_2/2)$ ..... (103)

and a primary reactance $x_1 + x^1{}_2$ ..... (104)

Substituting the above in formulas (62) and (64) derived for the maximum torque and the maximum output of a polyphase induction motor, we obtain the following expressions for the maximum torque and output of a single-phase induction motor.

$$T_{syn\ max} = \frac{V_1^2}{2\left[\left(r_1 + \frac{r'_2}{2}\right) + \sqrt{\left(r_1 + \frac{r'_2}{2}\right)^2 + \left(x_1 + 2x'_2\right)^2}\right]} \quad \ldots (105)$$

$$P_{max} = \frac{V_1^2}{2\left[\left(r_1 + \frac{3}{2}r'_2\right) + \sqrt{\left(r_1 + \frac{3}{2}r'_2\right)^2 + \left(x_1 + 2x'_2\right)^2}\right]} \quad \ldots (106)$$

It is seen from the above formulas that the pull-out torque of a single-phase induction motor is dependent upon the secondary rotor resistance contrary to what has been said of the polyphase motor. The maximum output of a single-phase induction motor is also to a greater extent reduced by secondary resistance and reactance than is the case with the polyphase induction motor.

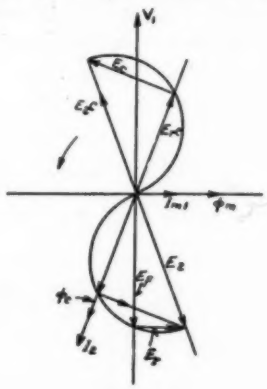


Fig. 57.

(g) The Equivalent Circuit of the Single-Phase Induction Motor.

Having arrived at the conclusion that the normally operating single-phase induction motor can, for practical purposes, be considered a polyphase induction motor having a primary resistance equal to $r_1 + r^1{}_2/2$ and a primary reactance equal to $x_1 + x^1{}_2$, we can, in the same way as has been done for the polyphase induction motor represent the entire single-phase induction motor circuit by the approximate "equivalent circuit" diagram shown in Fig. 55.

The equivalent circuit can be utilized for deriving the familiar circle diagram of the single-phase induction motor so convenient in workshop use.

THE REPULSION MOTOR (SERIES INDUCTION MOTOR).

(a) Vector Relations.

It has been stated that the single-phase induction motor is not self-starting and that the most popular method of starting up single-phase induction motors above ½ hp. is to temporarily transform the induction

motor into a series induction motor. Commercially the "self-excited, partly compensated, series induction motor" (Val. A. Fynn's nomenclature) is known under the name of "repulsion motor." We will very briefly explain the performance of the repulsion motor.

Fig. 56 shows the space diagram of the repulsion motor. The stator magnetizes in the direction ϕ_1, the rotor in the direction ϕ_2. It is clearly seen that the angle β formed by the stator axis with the direction of the rotor magnetization depends on the position of the brushes on the commutator. The torque may be considered due to the tendency of ϕ_1 and ϕ_2 to so arrange themselves that their axes coincide and to this conception the name "repulsion motor" may be due.

Assuming sinusoidal distribution of the ampere-turns, we can consider the rotor ampere-turns split into the two components:

$$AW_a = [1 - (4\beta/360)]i_2w_2 = i_2w_2 \cos\beta$$

magnetizing along the stator axis (in Fig. 56 these ampere-turns are shown by the heavy lines of the rotor circle)

and $AW_c = (4\beta/360)i_2w_2 = i_2w_2 \sin\beta$

magnetizing at a right angle to the stator axis.

The stator ampere-turns and AW_a combine to produce the flux of mutual induction ϕ_1, while the ampere-turns AW_c are producing the cross flux ϕ_c. ϕ_c combines with AW_a to produce the motor torque. Neglecting losses and leakage, the time diagram of the motor is represented by Fig. 57. The emf. V_1 applied to the stator terminals is responsible for the flux of mutual induction ϕ_m lagging 90° behind V_1. The flux of mutual induction induces by transformer action in the rotor conductors A to B and C to D in Fig. 56 the emf. E_p lagging 90° behind ϕ_m. Through rotation in the flux ϕ_m an emf. E_r is generated in the rotor conductors A to D and B to C in Fig. 56 in phase with ϕ_m as shown in the time diagram, Fig. 57. The resultant E_2 of E_p and E_r is the emf. E_2 acting between the brushes A and C.

The emf. acting between the brushes A and C on the rotor impedance will give rise to the rotor current I_2. The rotor current I_2 will lag behind E_2 by an angle determined by the ratio of ohmic to inductive resistance.

The cross flux ϕ_c is in phase with current I_2 and

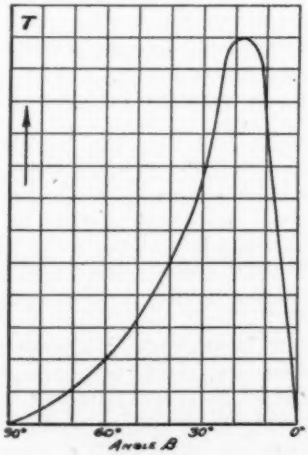


Fig. 58.

generates by rotation the emf. E_{rc} in phase with I_2 and by pulsation the emf. E_c in quadrature with I_2.

Having assumed no losses and no leakage, the resultant E_{2c} of E_{rc} and E_c will be equal to the emf. E_2 between the brushes. For a machine with losses and leakage the resultant of E_c and E_{rc} will have to be smaller than E_2, thus allowing the current I_2 to flow through the rotor impedance. E_{rc} is the counter emf. of the motor.

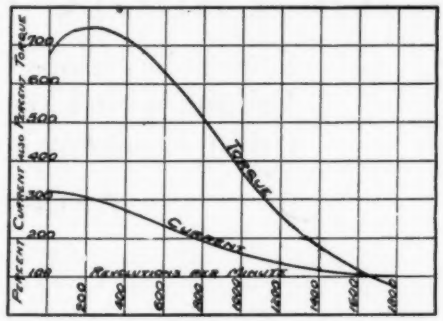


Fig. 59.

The values of the emf's shown in Fig. 57 can be obtained from the following equations:

$$E_p = 2\sqrt{2}\, f\, w_2 \cos\beta\, \phi_m 10^{-2} \quad \ldots\ldots\ldots\ldots (107)$$

$$E_r = 2\sqrt{2}\, f_2 w_2 \sin\beta\, \phi_m 10^{-2} \quad \ldots\ldots\ldots\ldots (108)$$

$$E_c = 2\sqrt{2}\, f\, w_2 \sin\beta\, \phi_c 10^{-2} \quad \ldots\ldots\ldots\ldots (109)$$

$$E_{rc} = 2\sqrt{2}\, f_r w_2 \cos\beta\, \phi_c 10^{-2} \quad \ldots\ldots\ldots\ldots (110)$$

(b) Starting Torque.

In starting, the emf's E_r and E_{rc} are zero. The current I_2 and the flux ϕ_c are in time phase and space quadrature and hence the starting torque is good.

Since the brushes are short-circuited E_2 is approximately zero and $E_c = E_p$

or from (107 and (109)

$$\phi_c = \phi_m \cot\beta \quad \ldots\ldots\ldots\ldots\ldots\ldots (111)$$

In accordance with equation (11) we can write for the starting torque in foot-pounds

$$T = 0.235\, p\, w_2 I_2 (\phi_c/\sqrt{2}) \cos\beta\, 10^{-2} \quad \ldots. (112)$$

Fig. 58 shows the relation between the starting torque and the angle of brush shift β. The starting torque is zero for a brush shift $\beta = 0$ and $\beta = 90°$.

(c) Torque and Power Output.

The power output according to equation (5) and Fig. 57 can be obtained by neglecting all negative torques from

$$p = E_{rc} I_2 \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots (113)$$

The torque can be obtained by dividing the power output through the angular velocity.

Fig. 59 represents the speed-torque and the speed-current curves of a repulsion motor, showing how large starting torques and quick acceleration can be obtained by this method of starting single-phase induction motors.

ALLENTOWN CONTRACTORS ELECT OFFICERS.

At the third annual meeting of the Electrical Contractors Association, Allentown, Pa., held on Jan. 23 at the Hotel Allen, A. S. Weible, of the Lehigh Electric Co., was elected president; James Hauck, Easton, vice-president; W. T. Kleppinger, Catasauqua, secretary; and H. H. C. Smith, Allentown, treasurer. The organization was formed three years ago, with a membership of 21 prominent electrical contractors from Allentown and neighboring sections. A number of interesting talks were given at the meeting, dealing, for the most part, with trade conditions existing at the present time, and the general outlook for future business.

Liability of Central-Station Company for Failure of Electric Power

Several Decisions Covering the Question of Power Failure, Both Through Negligence of Employes of Utility Company and Through Breach of Contract

By CHESLA C. SHERLOCK

THE consideration of the legal liability of electric central-station companies where there is a failure of current supply has brought up some very interesting questions. A few cases bearing on this subject will be cited, of which the first one does not involve a breach of contract.

In a Minnesota case, it was shown that the defendant owned and operated an electric light plant, furnishing electric current to consumers under contract with them. The plaintiff in the case owned a lot upon which was erected a two-story frame building. The front part of this building was operated by the plaintiff as a clothing store, while the back portion was operated by a different party as an eating house. A solid partition separated the two stores.

The defendant furnished electric current to the plaintiff under a contract which, among other things, provided "that the company shall use all due diligence in providing a regular and uninterrupted supply of current, but in case the supply of current shall be interrupted or be defective the company shall not be held liable therefor."

About 2:45 o'clock on a winter morning, fire broke out in the kitchen of the restaurant. The volunteer fire company, together with the plaintiff, four employes of the defendant and several citizens responded. The plaintiff opened his store and in trying to turn on the light discovered that his lights had been cut off. With the aid of several citizens, he attempted to remove his stock of goods, but after getting out one show case, gave it up because of the absolute darkness in his store.

In spite of the firemen's efforts, the fire broke through the solid partition 40 minutes after the plaintiff had opened his store and, as a result, the plaintiff's stock of goods was completely destroyed.

The evidence brought out the fact that Nick Finneman, an employe of the defendant power company, had come to the plaintiff's store some time before the latter had arrived, in an effort to save the company's meter. Finding the plaintiff's store locked and unable to gain entrance, he had climbed the pole from which the defendant's current was conveyed into the store and cut the wires, thus completely cutting off the plaintiff's lights.

It was contended before the court by the plaintiff's counsel that in thus cutting the wires before there was any necessity for doing so, the power company had failed to carry out the reasonable terms of its contract with the plaintiff and was guilty of willful negligence.

It was shown by several witnesses that if the lights had been working that the entire stock of goods could have been removed from the store within 20 minutes after the plaintiff arrived and at least 20 minutes before the fire finally broke through the partition.

The counsel for the power company contended that to say that it was the duty of the company to furnish lights in the case of a fire in the building would be a forced and strained construction to place upon the contract, and would be injecting into it an element which is not in express terms covered by the contract, and could not have been within the contemplation of the parties at the time it was made.

Decision of the Court.

In reaching its opinion, the court said: "The contract between the parties is not important, except for the bearing it has on the question of what the legal duty of the defendant was. It is not the breach of contract the plaintiff complains of, but a tort, actionable negligence on the part of a servant of defendant in the course of performance of his duties. We are unable to find that the state of facts has ever been presented to any court for its decision as to whether it constitutes actionable negligence. It is admitted that ordinances have been enacted in some cities requiring power companies to cut their electric wires in case of a fire, but there was no such ordinance in the city of Morris.

"We hold, however, that in case of fire, a power company supplying electricity to consumers has the right to cut its wires in case it is reasonably necessary to do so in order to save loss or damage to its property. But this does not answer the present question. While the company should not be compelled to take nice chances as to the particular moment of time when it is justified in severing the wires supplying current to a burning building, there certainly would be no excuse for such action in a case where it was apparent that there was no danger for hours of the fire reaching a point where the wires would be effected, and where it was apparent that the act might cause loss to the consumer.

"It cannot be said that the defendant owed no legal duty to the plaintiff. It could not cut off his supply of current arbitrarily and escape liability for consequent damages. We think it must be held that the legal duty of defendant was not to deprive the plaintiff unless and until the protection of his own interests, or the safety of the public, made it reasonably necessary to do so."

This seems to be the only case reported among the authorities where the claim for damages was based upon a tort. It is, however, admitted to be sound in principle and will, no doubt, pave the way for other decisions that may be handed down upon this point.

Some Cases Involving Breach of Contract.

A number of cases have been decided, however, where the action was brought for breach of contract. While these cases do not have a bearing in point with the case mentioned above, they are, at least, authorita-

tive in fixing the amount of damages, when such right to damages has been established.

In a New York case, the defendant power company had contracted to furnish current to plaintiff for the purpose of operating a stereopticon. The contract contained a provision that the company should have the right to shut off the current 10 days after bill was presented for the power used, provided such bill remained unpaid. The power company cut off the current three days after the presentment of bill. The court held that the company was liable in damages to the plaintiff for the injury suffered from the time of shutting off the current until the company gave notice that it intended to turn it on again.

In a California case, it was shown that the power company had contracted to supply electric current to a water company for the purpose of operating its pumps in pumping water for irrigation purposes. This was for a period of five years. The power company, without any notice to the plaintiff, cut off the current, removed its connections and refused to supply current according to the terms of the contract. The court held that the water company had the right to recover the excess damages suffered by reason of the necessity of procuring power from another company.

The real question to be determined in cases of this kind is: When, under similar circumstances, does the duty of the company to a consumer end, and the duty to the public and the right to protect its own property begin? The authorities seem justified in holding it a question of fact for the jury.

LYNN SECTION HEARS NAVAL LECTURE.

At the meeting of the Lynn (Mass.) Section of the American Institute of Electrical Engineers held on the evening of Jan. 22, Rear Admiral John R. Edwards, retired, of Bristol, Conn., gave an informal lecture on naval matters and emphasized the great value of the study of engineering. In the course of a long and active life in the naval service, including seven years off the coast of China, the admiral has had many interesting naval experiences from an engineering standpoint, and he paid a high compliment to some Chinese engineers for their skill in ship repairing.

The evolution of electric applications in naval service was reviewed in some detail, and the advance of naval construction and operation during the last 40 years was illustrated by anecdote and comparison. The speaker also touched on some of the industrial features of the modern navy. The lecture was more largely attended than any previous meeting of this section this season.

RADIO ENGINEERS DISCUSS RECEIVERS.

The Institute of Radio Engineers held an interesting meeting Feb. 5 in the Engineering Societies' building, New York City, at which the "Uni-Control Receiver" was explained by Roy E. Thompson. The development and construction of this important and practical form of single-control receiver was described in detail.

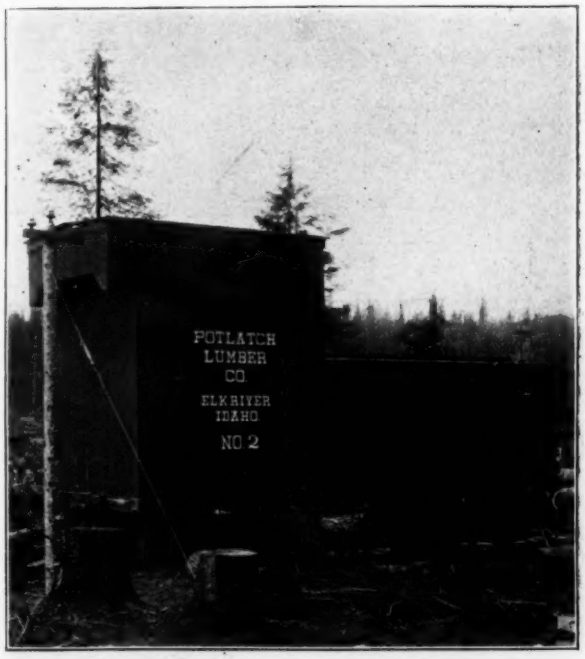
During the year 1918 the Stockton division of the Western States Gas & Electric Co. added 1090 electric consumers to its lines. There was an increase of 7063 hp. in connected load, of which 5339 hp. represents the increased load in motors.

ELECTRIC YARDING ENGINES SUCCESSFULLY OPERATED IN LOGGING OPERATIONS.

Notes on Skyline System in Idaho, and the Latest Installation in Western Washington.

The recent installation of a motor-driven double-drum hoist in the yarding camp of the Snoqualmie Falls Lumber Co., in western Washington, may serve to call attention to the fact that this is the second exemplification of logging by means of electric power in the timber regions of the West. The first installation was made and put in service in 1912 by the Potlatch Lumber Co. at Elk River, Idaho. This installation consisted of two electric logging engines by which the McFarlane Skyline System was put in use, especially adapted to the moving of logs from steep hillsides to the yarding or loading camp. The entire layout was from designs by E. J. Barry, electrical engineer, Tacoma, Wash., the complete equipment having been furnished by Willamette Iron & Steel Works of Portland, Ore.

A 1½-in. cable was anchored to standing timber on the crest of a hill, the other end being fastened to the hoisting drum of the engine installed at the yarding center. The cable in some cases extends as far as 4000 ft. from the winding engine. A trolley or carrier is attached to an endless line by means of which the logs are brought in with the lower end trailing on the ground. With a single setting the logs may thus be cleared from an entire hillside within the limits of travel. Then the main cable is moved to a new location and similar operations are carried out, and this plan of operation continues until an area having a



Transformer Car for Yarding Operations.

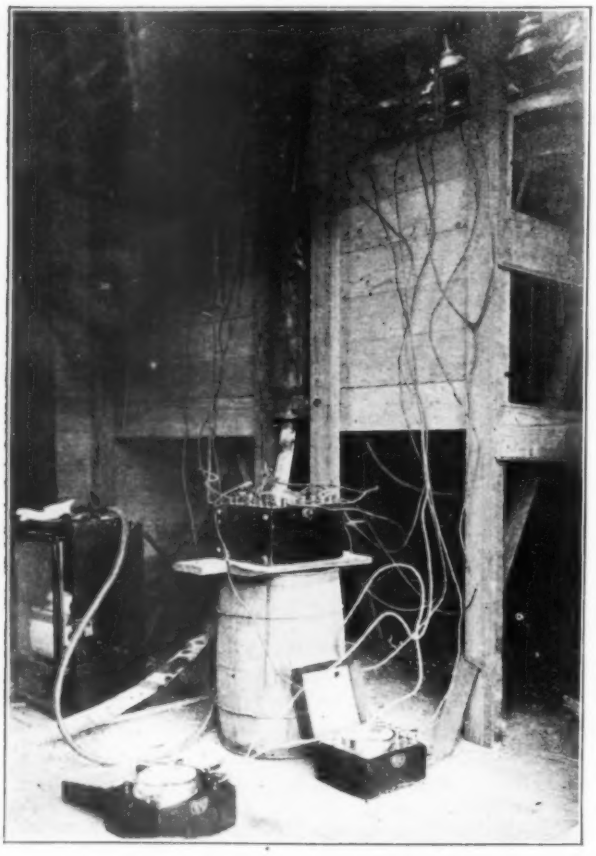
3000 to 4000-ft. radius has been cleared of the sawed timber.

Actual operations show that the logging engine may remain at one yarding station about two to three weeks when a new setting has to be made. It is contended that by this skyline method the logs, not being dragged over rocks and gravel beds, reach the mill in

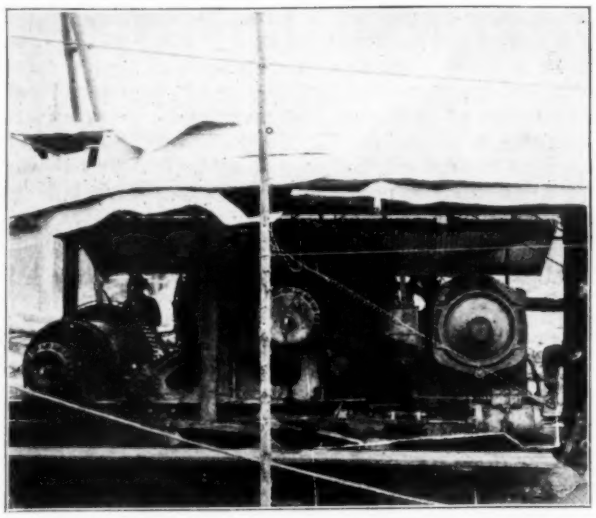
better condition for the saw. Inasmuch as the trailing end of the log is the only part that touches the ground, no obstacles are encountered to impede or stop the haulage, and this fact contributes additional space in handling.

The electrical equipment of each unit consists of one 150-hp. motor of 550 volts, 3 phase, 60 cycles, having a speed of 600 r.p.m. This is a logging type, wound secondary, and equipped with a solenoid brake. It is completely inclosed, of rugged construction, and has a 7-point controller connected to a bank of resistance grids at the rear of the skids on which the machine is mounted. The controller likewise operates the primary circuit, making a self-contained drive. The operator may always determine the stresses he can put on the steel cable by constantly having in view a time-element oil circuit-breaker switch and ammeter. In practice the motor is found capable of handling any load that the cable will stand. The brakes are operated by air applied from a compressor, driven by a 7½-hp. motor. Signal whistles, also operated by compressed air, are of special importance because the operator cannot always see the load and must depend upon signals from the hook tender.

The electric power is produced at the sawmill, situated 3 to 5 miles from the yarding camp, energy being transmitted at 11,000 volts to a portable substation, mounted upon a flat car, as shown in one of the illustrations, where it is stepped down to 600 volts. The power is then applied to the motor by means of a triple-conductor 000, lead-covered, steel-armored cable. The primary side of the 200-kw., 3-phase, oil-cooled transformers are protected by expulsion fuses and horn gap arresters. According to information



Interior of Transformer Car During Tests.



Electric Yarding Engine of Potlatch Lumber Co., Showing Drums and 150-Hp. Motor.

furnished by Mr. Barry, who supervised the installation, the average daily haul in 1912 was 33,000 ft. of timber for the No. 1 hoist, the rate of travel being 1000 ft. per minute, with an average load of 1700 log ft. The elimination of the fire hazard, the doing away with the necessity for fuel and boilers in the camp, the reduction of labor costs and the greater adaptability, are among the advantages of electric power in logging.

The more recent installation of electric logging equipment by the Snoqualmie Falls Lumber Co., in western Washington, consists of a 200-hp. induction motor, geared to a double-drum winding hoist; the large drum operates as a hoist, or log drag, and the smaller drum for the haul-back line. This outfit, especially built for the work, is equipped for variable speed, allowing a reduction of drum speed to 10 r.p.m. when tightening up on the choker, and then increasing to 24 r.p.m. for yarding the log. The motor, while rated at 200 hp., is capable of a heavy overload. Power at 550 volts is transmitted from a 250-kv-a. transformer to the motor by means of a 500-ft. submarine cable which may be safely laid in mud and water. This cable is wire-wound and rugged, and may be dragged through the woods when it becomes necessary to make a new setting. The main drum carries 1200 ft. of 1⅜-in. cable, and the drum ends are cemented to deaden the noise. The outfit operates over a radius of 1200 ft., the operations being guided by whistle signals provided for by a small motor-driven air compressor.

This is not the skyline system, however, as the logs are dragged at full length on the ground. The company's principal operations are carried on with steam yarding engines, and the trying out of the electric logging engine is affording a good opportunity to work up data on comparative costs and efficiency as to steam and electric service in this line of industry.

In this camp the power is generated at the company's electrically equipped sawmill two miles from the yarding center. At the mill the current is stepped up to 13,200 volts by a 250-kv-a. transformer for transmission to the yarding center, where a transformer of similar capacity steps the energy down to the 550 volts required for the motor. It is probable that a transformer of greater capacity may be installed at the yarding center.

Central-Station Census Statistics

Data for Nevada, Vermont, Mississippi, New Mexico and Utah

Preliminary figures of the forthcoming quinquennial report on the central electric light and power stations of five additional states have been given out by Director Sam. L. Rogers, of the Bureau of the Census, Department of Commerce. They were prepared under the supervision of Eugene F. Hartley, and are in continuation of the statistics published in our issues of Jan. 4 and Feb. 1, 1919.

The statistics relate to the years ending Dec. 31, 1917, 1912, and 1907, and cover both commercial and municipal plants. They do not, however, cover electric plants operated by factories, hotels, etc., which generate current for their own consumption; those operated by the Federal Government and state institutions; and those that were idle in course of construction.

The figures presented for Utah show a remarkable growth in the central electric light and power stations, more pronounced during the later five-year period, from 1912 to 1917. The total number of companies reporting increased 14 from 1907 to 1912 and only two from 1912 to 1917. The number of stations, however, has but little significance because of the tendency to combine in a single system two or more plants that previously reported as independent stations. From 1912 to 1917 the income increased $3,895,542, or 251.4%, compared with an increase of $844,024, or 132.9%, from 1907 to 1912. From 1912 to 1917 the output of stations shows a gain of 380,360,478 kw-h., or 439%, compared with an increase of 24,961,997 kw-h., or 40.5%, from 1907 to 1912. Unlike most of the states for which such figures are presented, Utah shows a large increase from 1912 to 1917 in the number of arc street lamps, the gain in incandescents being comparatively insignificant.

The figures presented for New Mexico show substantial gains for each five-year period. From 1912 to 1917 the income increased $396,312, or 79.6%, compared with a gain of $205,213, or 70.1%, from 1907 to 1912. From 1912 to 1917 also the actual increase in expenses, $395,059, or 87.9%, was greater than from 1907 to 1912, when the gain was $222,579, or 98.1%.

The total number of establishments reported for Mississippi increased at a nearly uniform rate between 1907 and 1917, from 68 in the earlier year to 97 in the later. The figures for most of the remaining items show greater increases, both actually and proportionately, from 1907 to 1912 than for the following five-year period.

The growth of the industry from 1907 to 1912 continued during the following five-year period. The fact that the total number of establishments was smaller by two in 1917 than in 1912 does not give a true impression of the conditions, as 10 establishments were reported for the first time in 1917, the net decrease being due to consolidations among the companies rather than to the discontinuance of operations. From 1912 to 1917 the income increased $781,154, or 63.6%, compared with an increase of $386,660, or 45.9%, from 1907 to 1912. The increase in total horsepower and in the capacity of dynamos was greater, both actually and relatively, from 1912 to 1917 than from 1907 to 1912. From 1912 to 1917 the output of stations increased 22,419,620 kw-h., or 52.6%, compared with 12,736,551 kw-h., or 42.6%, from 1907 to 1912. Consistently with the general trend of street lighting, Vermont shows a decided decrease in the use of arc lamps for this purpose since 1907.

The figures for Nevada show general increases at each succeeding census. The income and expenses increased during both five-year periods, but it is noticeable that the percentage of increase in expenses was greater than that for income.

The figures are shown in detail in the accompanying tables:

CENTRAL-STATION STATISTICS FOR THE STATE OF NEVADA.

	1917.	1912.	1907.	Per cent of increase.[1] 1907 to 1917.	1912 to 1917.
Number of establishments	14	8	9	55.6	75.0
Commercial	13	7	9	44.4	85.7
Municipal	1	1	..	.....	.....
Income	$938,929	$618,942	$372,108	152.3	51.7
Electric service	$833,088	$607,597	$352,959	136.0	37.1
All other	$105,841	$ 11,345	$ 19,149	452.7	832.9
Total expenses, including salaries and wages	$662,359	$428,255	$245,291	170.0	54.7
Number of persons employed	190	147	78	143.6	29.3
Salaries and wages	$144,012	$113,636	$ 77,264	86.4	26.7
Total hp.	16,832	15,420	6,980	141.1	9.2
Steam engines:					
Number	5	6	4	25.0	—16.7
Hp.	1,100	2,210	235	368.1	—50.2
Internal-combustion engines:					
Number	8	8	6	33.3	....
Hp.	617	670	485	27.2	—7.9
Water wheels:					
Number	21	13	9	133.3	61.5
Hp.	15,115	12,540	6,260	141.5	20.5
Kilowatt capacity of dynamos	12,353	10,513	5,690	117.1	17.5
Output of stations kw-hr.	53,846,178	44,969,772	29,621,730	81.8	19.7
Stationary motors served:					
Number	970	553	411	136.0	75.4
Hp.	15,874	12,384	6,850	131.7	28.2
Number of street lamps:					
Arc	14	204	[2]	.....	—93.1
Incandescent, etc.	1,003	401	[2]	.....	150.1

[1]A minus sign (—) denotes decrease. [2]Not available.

ELECTRIC LIGHT AND POWER STATISTICS FOR VERMONT.

	1917.	1912.	1907.	Per cent of increase.[1] 1907 to 1917.	1912 to 1917.
Number of establishments	59	61	60	—1.7	—3.3
Commercial	43	48	47	—8.5	—10.4
Municipal	16	13	13	23.1	23.1
Income[2]	$2,009,515	$1,228,361	$841,701	138.7	63.6
Electric service	$1,937,974	$1,182,797	$795,391	143.7	63.8
All other	$71,541	$45,564	$46,310	54.5	57.0
Total expenses, including salaries and wages	$1,611,292	$824,443	$682,003	136.3	95.4
Number of persons employed	443	340	297	49.2	30.3
Salaries and wages	$350,735	$219,897	$188,780	85.8	59.5
Total hp.	73,760	50,363	38,566	91.3	46.5
Steam engines:					
Number	32	40	41	—22.0	—20.0
Hp.	17,285	14,996	9,889	74.8	15.3
Internal-combustion engines:					
Number	1	2	4	—75.0	—50.0
Hp.	50	95	205	—75.6	—47.4
Water wheels:					
Number	109	108	101	7.9	0.9
Hp.	56,425	35,272	28,472	98.2	60.0
Kw. capacity of dynamos	51,751	29,468	21,854	136.8	75.6
Output of stations, kw.-hrs.	65,079,504	42,659,884	29,923,333	117.5	52.6
Stationary motors served:					
Number	3,448	1,966	776	344.3	75.4
Hp.	43,503	23,695	9,778	344.9	83.6
Number of street lamps:					
Arc	356	1,013	[3]	.....	—64.9
Incandescent, etc.	9,046	5,563	[3]	.....	62.6

[1]A minus sign (—) denotes decrease. [2]Exclusive of $224,884 in 1917 and $110,357 in 1912, reported by street and electric railway companies as income from sale of electric current. [3]Not available.

CENTRAL-STATION STATISTICS FOR MISSISSIPPI.

	1917.	1912.	1907	Per cent of increase.[1] 1907 to 1917.	1912 to 1917.
Number of establishments	97	82	68	42.6	18.3
Commercial	46	35	29	58.6	31.4
Municipal	51	47	39	30.8	8.5
Income[2]	$1,302,397	$1,167,787	$ 686,700	89.7	11.5
Electric service	$1,283,333	$1,146,583	$ 667,543	92.2	11.9
All other	$ 19,064	$ 21,204	$ 19,157	—0.5	—10.1
Total expenses, including salaries and wages	$1,047,670	$ 878,379	$ 519,869	101.5	19.3
Number of persons employed	451	407	288	56.6	10.8
Salaries and wages	$ 272,046	$ 263,793	$ 161,433	68.5	3.1
Total hp.	33,288	30,497	15,522	114.5	9.2
Steam engines:					
Number	130	128	106	22.6	1.6
Hp.	32,245	30,457	15,497	108.1	5.9
Internal-combustion engines:					
Number	29	1	1	2,800.0	2,800.0
Hp.	1,043	40	25	4,072.0	2,507.5
Water wheels:					
Number	.....	.....	.....	.....	.....
Hp.	.....	.....	.....	.....	.....
Kilowatt capacity of dynamos	23,246	21,863	9,884	135.2	6.3
Output of stations, kw.-h.	30,498,101	27,924,183	15,704,624	94.2	9.2
Stationary motors served:					
Number	1,217	701	181	572.4	73.6
Hp.	13,767	7,955	1,520	805.7	73.1
Number of street lamps:					
Arc	778	1,663	[3].....	.....	—53.2
Incandescent, etc.	8,240	4,001	[3].....	.....	105.9

[1]A minus sign (—) denotes decrease. [2]Exclusive of $583,515 in 1917, $273,217 in 1912, and $308,053 in 1907, reported by street and electric railway companies as income from sale of current. [3]Not available.

CENTRAL-STATION STATISTICS FOR NEW MEXICO.

	1917.	1912.	1907	Per cent of increase.[1] 1907 to 1917.	1912 to 1917.
Number of establishments	29	21	15	93.3	38.1
Commercial	25	18	15	66.7	38.9
Municipal	4	3	.....	.....	33.3
Income	$894,207	$497,895	$292,682	205.5	79.6
Electric service	$874,317	$488,422	$289,962	201.5	79.0
All other	$ 19,890	$ 9,473	$ 2,720	631.2	110.0
Total expenses, including salaries and wages	$844,575	$449,516	$226,937	272.2	* 87.9
Number of persons employed	256	158	83	208.4	62.0
Salaries and wages	$223,510	$119,088	$ 66,981	233.7	87.7
Total hp.	17,108	11,015	4,548	276.2	55.3
Steam engines:					
Number	37	32	26	42.3	15.6
Hp.	13,226	8,428	4,035	227.8	56.9
Internal-combustion engines:					
Number	22	9	.....	.....	144.4
Hp.	3,252	1,770	.....	.....	83.7
Water wheels:					
Number	7	9	6	16.7	—22.2
Hp.	630	817	513	22.8	—22.9
Kilowatt capacity of dynamos	12,713	7,981	3,789	235.5	59.3
Output of stations, kw.-h.	17,244,768	9,027,824	4,614,349	273.7	91.0
Stationary motors served:					
Number	729	639	195	273 8	14.1
Hp.	7,626	4,084	1,231	519.5	86.7
Number of street lamps:					
Arc	13	247	[2].....	.....	—94.7
Incandescent, etc.	2,288	627	[2].....	.....	264.9

[1]A minus sign (—) denotes decrease. [2]Not available.

CENTRAL-STATION STATISTICS FOR UTAH.

	1917.	1912.	1907	Per cent of increase.[1] 1907 to 1917.	1912 to 1917.
Number of establishments	47	45	31	51 6	4.4
Commercial	25	28	22	13.6	—10.7
Municipal	22	17	9	144.4	29.4
Income	$5,444,807	$1,549,265	$ 665,241	718.5	251.4
Electric service	$4,965,930	$1,530,060	$ 627,332	691.6	224.5
All other	$ 478,877	$ 19,205	$ 37,909	1,163.2	2,393.5
Total expenses, including salaries and wages	$1,018,963	$1,206,729	$ 461,675	770.5	233.0
Number of persons employed	1,215	401	198	513.6	203.0
Salaries and wages	$ 937,869	$ 365,399	$ 159,686	487.3	156.7
Total hp.	226,595	60,588	35,950	530.3	274.0
Steam engines:					
Number	15	6	10	50.0	150.0
Hp.	34,189	1,000	1,279	2,573.1	3,318.9
Internal-combustion engines:					
Number	.....	.....	.....	.....	.....
Hp.	.....	.....	.....	.....	.....
Water wheels:					
Number	112	63	45	148 9	77.8
Hp.	192,406	59,588	34,671	454.9	222.9
Kilowatt capacity of dynamos	147,359	37,935	33,592	338.7	288.5
Output of stations, kw.-h.	466,995,136	86,634,658	61,672,661	657.2	439.0
Stationary motors served:					
Number	1,046	1,044	406	157.6	0.2
Hp.	126,555	37,490	5,519	2,193.1	237.6
Number of street lamps:					
Arc	2,638	321	[2].....	.....	721.8
Incandescent, etc.	7,697	5,237	[2].....	.....	47.0

[1]A minus sign (—) denotes decrease. [2]Not available.

ELECTRICALLY OPERATED DEEP-WELL CENTRIFUGAL PUMP FOR RAILROAD SHOPS AND YARDS.

The electric pumping equipment, lately completed, to serve the shops and yards of the Oregon-Washington Railroad at Albina station, Portland, Ore., is typical of the modern deep-well multistage centrifugal pump direct-connected to a high-speed motor, vertical type, having automatic starting through contactor panels. The water is pumped from two caissons sunk 40 feet to allow inlets thereto from Willamette River and is discharged directly into pressure mains below the shop and yard surface, there being no standpipe nor reservoir.

The two steel caissons, each 54-in. diameter, extend from the floor level of the pump house to 4 ft. below zero stage of water in the river, there being a 10-in. connection between them near the base. A 10-inch inlet was extended from one of the caissons into the stream. The lower 13 ft. of the caissons were given a heavy sheath of reinforced concrete, from 12 in. to 16 in. thick.

Each caisson contains a Byron Jackson, 8-stage centrifugal pump of the rated capacity of 650 g. p. m., and is direct-connected to a 75-hp. vertical-type motor, wound for 3 phase, 60 cycles, 440 volts, and having a speed of 1200 r. p. m. The motors are equipped for automatic starting through contactor panels, those operations being by air pressure in pipes through pressure gauges and relays mounted upon the control panel. The plan is to operate only one pumping unit at a time, except in case of fire or other necessity, and by the use of a double-throw 4-pole switch it is possible to alternate the motors and thus equalize them in service. The starting panels are provided with power-limiting relays to open the circuit and protect the motors, and also inverse time-limit relays.

There is an 8-inch discharge pipe leading from the pump in each caisson to the surface line, where the discharges from both pumps form a Y and unite in a pipe line that contains an 8-in. Neptune meter from which the water passes on into the main supply line. There are, however, by-passes around the meter, with valves for thus controlling the flow of water.

BRITISH PLAN POWER CONTROL.

Control of the generation and distribution of electricity throughout the United Kingdom is proposed by a bill now being prepared by the government.

Authority over electric supply, which now is vested in the Board of Trade and other government departments, would be transferred by the bill to a very small board having probably only five members.

All electric power stations would be purchased and placed in the hands of local boards, each of which would be held responsible for the supply of electricity in its district. If private companies wish to enter the electric business they would be compelled to buy their current from the local board and their earnings would be under control.

Editorial Comment

Harnessing Our Water Powers

THE subject of utilizing our water power is so time-worn, has been discussed *ad nauseum* for so long and with so little useful result, that it would seem hardly worth while to broach this subject again, either to plead or chide. However, our national water powers—the precious white coal—are going to waste, where so many of them could be put to good use, a rebuke to our indifference, a monument of our inertia and national extravagance.

Elsewhere in this issue will be found an article by D. H. Colcord that deals with hydroelectric developments and resources of the Eastern United States. It is sincerely hoped this article will serve to bring home to those blind or stubborn "powers that be" the latent possibilities of water powers that now go to waste where they might be turned to usefulness; and rouse the fight in those that in the past have championed the cause of harnessing our national water powers. Something ought to be done, something must be done, to bring about a change in the short-sighted policy that gains nothing, aims at nothing, and only encourages a waste of energy that borders on the criminal.

The value of a water-power site depends upon its accessibility to a market for energy, and it is the cost of selling the hydroelectric energy from a water power that decides whether that water power is worth developing in a financial way. Sometimes the market for electrical energy develops around the water-power site. Usually, however, energy is transmitted from the water-power site to the market. It is certainly more scientific and more efficient to transmit electrical energy along wires than to transport coal by rail or water, and it is usually cheaper. The efficiency of transforming energy stored in the water to electrical energy is in the neighborhood of 80%; best steam practice, and the best steam practice is the exception rather than the rule, permits less than 20% of the chemical energy in the coal to be transformed into electrical energy.

Our method of burning coal for power and home plants is wasteful and unscientific, for we obtain little of what we endeavor to obtain, namely, heat, and lose many products that we need, while befouling the atmosphere and creating objectionable conditions generally in the process. The use of gas for heating purposes in power plant and elsewhere, carbonization of the coal for its thousand and more by-products, and the use of coke, the residue, as fuel is a condition that we look to as a palliative for the extravagant, rapid and senseless consumption of coal that is now going on. But that time is not yet. Meanwhile water power should be used instead of coal wherever feasible, and this condition will not obtain so long as the development of our water powers is dependent upon the initiative of private enterprise and investment of private capital handicapped by unprogressive legislation. The problem is a nation-wide and national one. Dr. Steinmetz has shown that even if all the country's hydraulic energy were developed for hydroelectric energy supply, little more than the total energy now produced from coal could be obtained. And such a condition is impractical. But because the one extreme is not feasible is no reason why those water powers that permit should not be turned to the use of man.

Every kilowatt-year produced by water power represents one ton of coal saved, had coal been used; for, roughly speaking, one ton of coal is required to produce one kilowatt-year. The subject of water-power development is, therefore, a vital one, of nation-wide concern. Unfortunately, this coal-saving medium, white coal, is being permitted to go to waste, because its development is dependent chiefly upon private enterprise and private capital expended for private gain, and existing legislation is considered such as to handicap instead of encourage investments aiming to put our water powers to use. The time has come when a sound, sane, and wise nation-wide hydroelectric policy should no longer be held in abeyance. Hydroelectric developments should be encouraged, not prohibited.

The time to agitate, the time to have some action taken—and we are not concerned whether that action be taken by private, state or federal capital—upon harnessing our water powers, is now. Every ton of coal used when the energy could be obtained from water power is coal wasted and squandered. It is a national disgrace. It is a matter of deep concern for every true and patriotic citizen. It is not with today, alone, with which we are concerned. It is with the future.

Electric Drive in Cement Mills

WE are so accustomed to the application of electric drive in industry that we now ordinarily accept it as a matter of course, if we notice it at all. Electric drive fits into the scheme of things; in many schemes and undertakings it is a *sine qua non*. One of these latter is the production of cement.

The production of cement embraces, primarily, the handling of large quantities of material. This material must be kept on the move, must be subjected to a number of treatments of varied kinds, several of which subject equipment to extremely severe service. The process of making cement is such that the process must be continuous, otherwise costs of production

immediately rise and the quality of the product goes down or becomes a waste product. In meeting these conditions electric drive is without a competitor. It is flexible, it is reliable, it offers the ease of control required and continuity of operation, it enables the whole process from quarry to sack to be made automatic, which means ease of supervision and duplication of results.

As electricity plays such a large part in the electrically driven cement mill, and every large modern cement mill is electrically driven, presumably, the cost of electrical energy is an important factor in determining the cost of the cement. Low cost per kilowatt-hour produced or purchased, low energy consumption by efficient transmission and distribution, correct motorization and motor applications, and a high degree of maintenance make for low electrical energy costs. Many cement mills produce their own power; many more purchase it. Although heat plays a vital part in producing cement from limestone and shale, the power situation at the cement mill is different from that at many other industrial plants where heat is used and electricity may be produced as a by-product. Pulverized coal is invariably employed for clinkering in the kilns, an entirely separate and segregated application of heat from that of raising hot water or steam. A cement mill producing its own power must do so as a separate undertaking from that of making the cement. Even so, the utilization of waste heat may sometimes offer an opportunity for such plants to save fuel.

The load of the cement mill is in normal times a load of high load-factor, and the load-factor is closely related to the success of the undertaking. The load is a comparatively steady one, within rather wide limits. It is more steady than the electric furnace load where one or two furnaces are in operation, but less steady than the ordinary industrial plant using motor drive. The cement mill is a load that the central-station company will usually find worth while. The central-station power engineer is somewhat of a Jack-of-all-trades and master of many, for he is called upon to introduce central-station service into many and varied undertakings. A description of a cement mill that appears in another part of this issue should prove of interest to all power engineers and others anxious to familiarize themselves with the application of electric power to industrial processes.

Industrial Promise Lies at Home

THE following editorial from a recent issue of the New York *Sun* is a logical and far-seeing presentation of the facts in the case, and we believe it will interest and benefit all who see it:

"There is nothing new for readers of *The Sun* in the discovery of Charles M. Schwab, the great steel man now in France, that in the devastated regions of that country there will be little or no reconstruction work for America. Some seven weeks ago this newspaper, in this very column, made that fact clear, with the simple explanation that the great bulk of the structures destroyed in France and in Belgium was of stone and brick. The rebuilding will be of stone and brick, done with French material and by French hands.

"For those who knew anything about France there never was any question about this. For those who knew anything about the steel situation in the United States the hallucination that excessive prices could be held up here by pouring our steel into Europe for the peace work of reconstruction as our steel had been poured into Europe for the war work of destruction was as wild an economic dream as ever was dreamed.

"The hope of American industry does not lie in a huge demand by devastated France and destitute Germany and chaotic Russia for our steel, our copper, our fuel and other basic materials for manufacture. There is no such huge demand; there will be none for a long time. Our industrial promise lies and will lie at home.

"Here in the United States there is a wide and there will be a continuous market for those articles—at the right prices. While this country has been at war, and while before we ourselves were at war, this country was supplying Europe with war material, our normal industry and our normal business were starved of their normal supplies. Our normal industry and our normal business are ready now to go ahead again full speed when normal supplies can be had at something like normal prices. They will not go ahead on any basis of abnormal war prices.

"The building that would like to begin in this country, the manufacture that would like to begin in this country, the merchandising that would like to begin in this country, are all waiting for prices and general economic conditions that will permit them to do normal business—the only kind of business that can be done in worth while and continuous volume, now that the war is over.

"The worst thing that can happen to American capital, the worst thing that can happen to American labor, the worst thing that can happen to American institutions is for this waiting for normal markets to go on and on while the nation's industrial power and vigor ooze away.

"Get down to normal markets and we can resume business. Resume business and we can thrive and prosper, though we never do a penny of reconstruction work in Europe, Asia or Africa."

There is an economic truth in the above timely and forceful comment. We have the markets right here at home and they should be cultivated strongly and promply, for in that way lies prosperity and progress for the United States.

The frequent discussions of the opportunities that lie in the development of foreign markets, while they have (as they should) directed attention to these neglected fields, have also caused many to forget the possibilities that exist right here among us. Every effort should therefore be made to hasten the return of normal conditions here where our chief business will always be.

Week's Events

A. I. E. E. Convention Program—Activity in British Electrical Contracting Field—Government Ownership Opposed

PROGRAM FOR MIDWINTER CONVENTION OF A. I. E. E.

Interesting Three-Day Meeting to Be Held in New York City.

The seventh annual midwinter convention of the American Institute of Electrical Engineers will be held Feb. 19-21 in the Engineering Societies Building, 33 West 39th street, New York City. The convention will open Wednesday afternoon in joint session with the American Institute of Mining Engineers, at which a symposium on "Electric Welding" will be presented. Members of the American Society of Mechanical Engineers are also invited to participate in this session. Wednesday evening will be devoted to a lecture by Dr. John A. Brashear, on "An Evening with the New Astronomy," which will be followed by an exhibition of technical moving pictures as adopted by the War Department for the instruction of the army in the operation of various mechanical devices. The pictures will be accompanied by brief explanatory remarks. Ladies will be welcome at this session, as these subjects will be handled in a popular manner.

On Thursday morning and on Friday morning and afternoon there will be technical sessions. Thursday afternoon will be devoted to a technical excursion to the Brooklyn Navy Yard, by courtesy of the Navy Department. Opportunities to visit the prominent electrical plants in New York and vicinity during the time of the convention have also been provided. On Thursday evening there will be a dinner-dance at the Hotel Astor for members and guests in attendance at the convention.

The detailed program of the technical sessions is as follows:

Wednesday Afternoon—"Microstructure of Iron Deposited by Electric Arc Welding," by G. F. Comstock. "Path of Rupture in Steel Fusion Welds," by S. W. Miller. "Welding Mild Steel," by H. M. Hobart. "Electric Welding in Shipbuilding," by S. V. Goodall. "Fusion in Arc Welding," by O. H. Escholz.

Thursday Morning—Address, by President C. A. Adams. "The General Equation of the Electric Circuit—III," by C. P. Steinmetz. "Review of Work of Subcommittee on Wave-shape Standard, of the Standards Committee," by H. S. Osborne.

Friday Morning—"Ionization of Occluded Gases in High-Tension Insulation," by G. B. Shanklin and J. J. Matson. "The Dielectric Strength of Air Films Entrapped in Solid Insulation," by F. Dubsky. "Abnormal Voltages in Transformers," by L. F. Blume and A. J. Boyajian.

Friday Afternoon—"Aero Telephony," by E. B. Craft and E. H. Colpitts. "Theory of Transient Oscillations," by John R. Carson. "Telephone Circuits with Zero Mutual Induction," by the late W. W. Crawford.

COMING ACTIVITY IN ELECTRICAL INSTALLATION WORK IN ENGLAND.

Interesting Summary of Conditions in Electrical Contracting Field—Some Difficulties Like Those Here—Dangers of Cheap Work and Shoddy Materials.

The withdrawal of restrictions upon the connecting up of new electrical installations in England opens the way for British electrical contractors to resume some of their pre-war activities. A review of British conditions may therefore be of some interest to American contractors. During the period of the war some of the more important firms who have made a specialty of installation work have had some very big operations demanding their attention. Individual contracts for light and power equipments for new and converted factories required for producing war munitions have employed thousands of men and involved four, five, perhaps even six figures, in pounds sterling. It would not be far wrong, we believe, to state that there are cases where one big war contract has meant a turnover quite equal to the operations of a complete year or even two in the old days. Further than this, there has been much to be done in the electrical lighting and power work for big camps, cooking installations for canteens, and so forth. War-time prices, too, have been the cause of less anxiety than have those of pre-war days, for the electrical installation business was one of those departments of industry in which competition in ordinary times was positively reckless.

Now that there are no more national factories or camps to occupy attention, the installation contractor will be able to concentrate on the classes of business which are part and parcel of the work of general electrical development, including domestic lighting, heating, cooking and small power, also power work in factories engaged in manufacturing articles which were not nationally essential in war time. He will also find new canteen work as the outcome of welfare progress, while in the shipbuilding industry there will be practically no limit to the service to be rendered by those firms who have made a specialty of the installation of electric power, light, heat, telephones, etc., in ships. The withdrawal of the restrictions on new connections by the Ministry of Munitions reminds one that in the domestic domain in particular there are big arrears of work waiting. Where big power systems were loaded to the full with munition works demand for electricity, the new private consumer had to stifle his ambitions and put up with some other agent for illumination or heating. In other places, where stations had no power load for war manufacturing, they were not assisted by the Government to obtain new plant equipment for extensions, so that the private householder even there had to wait. And where neither of these objections presented themselves, the contractor found the difficulty of obtaining the necessary materials an insuperable obstacle.

If all these points are considered in relation to the coming situation, we cannot but feel that there will be plenty of work for the large body of electrical wiremen and other installation employes who are now available in England, though we must not overlook the fact that electrical contracting work in the coming days will be far more costly than it used to be. All materials at present are necessarily higher in price and wages have considerably increased. Against this adverse factor we may be allowed to place the advantage that undoubtedly accrues from the universal education of the last year or two concerning the need for conserving fuel supplies and the usefulness of electricity as a means for securing this desired economy.

Those who have more than a passing knowledge of the electrical contracting trade cannot fail to remember that there were some decidedly regrettable influences at work not so very many years ago. The "mushroom" contractor and his ways amounted to little short of a scandal in the old days, and some of the work done was little better, while the manufacturer who supplied the offender with the material sometimes saw little payment in return and was even known to have to go in and finish a job for himself. Happily, the business is now better organized, though a great deal remains to be done in that connection. The Electrical Contractors' Association scheme for guaranteeing good work was a movement in a direction that everybody with the genuine interests of the industry ought to have encouraged. It is to be hoped too that the Electrical Trades' Union, which is now so much stronger numerically and has so persistently championed the cause of the employes in respect to wages and conditions of work, will use its influence to secure good work from its members. In the old days, however, it was not always bad workmanship that brought electrical installation work into disrepute occasionally; bad material played its part and an important one, too. It was pretty generally known, we believe, that electrical contracting work was frequently done at cut prices by reason of the large quantity of cheap imported electrical supplies that found their way in from countries whose "world-power" ambitions have now been shattered. It is possible that here and there the consumer could not afford to put electricity into his house unless it could be done "dirt cheap," but there is certainty that other classes of consumers, even if they were not "out" for cheapness, were inclined to favor the lowest estimate put in, though they did not know that poor material and poor labor were what they were favoring when they rejected all higher tenders.

During the war many small electrical men have saved a few hundred pounds and their present desires are to rush into electrical contracting work when they think we are at the beginning of a boom. There can be no legitimate objection to the small man *per se*. Many important undertakings have, of course, risen from very small beginnings and there is little reason why this should not happen in electrical contracting work. Unfortunately, however, unless the said small man has a little preserve of his own with practically nobody to put up competition, the temptation will be for him to "cut" his first few jobs in order to become established. It will be regrettable indeed if he succumbs to the temptation. So far as cheap and shoddy material is concerned we do not think he will be able to get it from the former sources for some time to come and probably never again at the old prices. We trust that he will not be able to obtain it from British manufacturers; we do not think he will, though we believe that there is ample room for British manufacturers to lay themselves out to produce cheaper lines than formerly without too great a sacrifice of quality. Though enemy countries will not be sending supplies of such goods direct for some time to come, there are other countries which may pass them on and there are neutral countries which may themselves manufacture these cheaper lines of accessories. Whether they do or not, it is common knowledge that Japan has made giant strides in the production of small electrical appliances and material during the war. The first year or two of the war did not give their output a reputation either in England, or in India or Australia, but it is understood that with experience and with greatly increased output the Japanese factories have been changing that reputation. It is recognized that in China, in Russia, in India, etc., Japanese electrical suppliers have had a grand opportunity when owing to shipping and other adverse conditions British firms have not been able to meet the requirements of those markets. America will also doubtless count more largely in such places than she has done in the past. In addition to this some of the bigger electrical manufacturing concerns in England have launched out into the production of the smaller articles for installation work.

It will be some time before things find their level in regard to labor, material, and so forth, but it is certain that there is plenty of work waiting and it would be gratifying if one could feel entirely confident that there were no likelihood of the standard of work being affected, and the profits of the industry spoiled, by some of the unfortunate practices of the past being repeated. The best interests of the industry as a whole, as well as those of the individual master contractor and of the individual electrical trade unionist, would, we should have thought, be found along the line of efficiency maintenance. If the responsible firms agree as to that it will be something to the good, but to safeguard an industry into which any small man or bell-hanger can enter, against occasional lapses, is practically impossible.

PRICES OF ELECTRICAL SUPPLIES ON PACIFIC COAST MAY DECLINE.

Closing Shipyards by Labor Strike Affecting Allied Industries—Tendency of Prices Lower.

Electrical material prices on the Pacific Coast have held at a steady figure generally, although a slight drop in copper wire and conduits are reported. In some quarters a tendency toward a decline is observed, and there exists conditions which may cause lower prices. Stocks on the coast are considered heavy, and disturbed labor conditions in the metal trades foreshadow a slackening in demands, especially in the shipbuilding industry. The tieing up of all ship work in Puget Sound yards by the strike of about 35,000 workers is having the effect of cutting out the work of many small shops and factories that depend upon shipbuilding activity.

The strike is, on the surface, a protest against the Macey award made two months ago by the joint action of the Government Shipping Board, and the Federal Labor Board, when both employes and employers were heard. The strikers demand a basic wage of $8 per day. No one in the west looks for an acceptance of the advance demanded. A long continuance of the shut-down may bring a material decline in electrical prices, because with the big supplies required in ship-

building cut off for a time the sale of stock would fall below normal and cause a break in prices. A strike of equal proportions among the shipyard men on San Francisco Bay is threatened at this writing, and if not averted the foregoing conclusion will be merely accentuated. Workers in the Portland yards are holding their positions thus far and probably will not go out. The strike on Puget Sound is clearly on motion of the radical members of Bolsheviki tendencies.

Prices of electrical appliances for domestic uses have held up well, and dealers have had fairly good sales through the winter; but with the efforts to push sales at the opening of spring there is likely to come a lower level of prices, though no radical slumps.

Those who have money to employ in building operations have been holding back, and their attitude will tend to hasten some reduction in costs. In other words, the return to normal activity awaits a settling of prices that will make the investor and contractor feel safe to go ahead.

NEW RECORD SET BY NOVEMBER ELECTRICAL EXPORTS.

Cessation of War Stimulates Electrical Foreign Trade—October Electrical Exports Also Fairly Heavy.

While it may have been a coincidence, the statistical information so far at hand at least seems to indicate that the signing of the armistice and cessation of the war has materially stimulated the foreign trade in electrical goods made in the United States. The November electrical export total broke all previous records, having for the first time exceeded a monthly total of $6,000,000. The November total was really nearly 8% over that of December of 1917, which was the preceding highest monthly total; it was also over 14% above the total of November, 1917.

These statements are based on the monthly summary of the foreign commerce of the United States issued by the Bureau of Foreign and Domestic Commerce, Washington, D. C. The data for October have also become available. In the following table are given the figures for October and November, 1918, and for the corresponding months of 1917.

Articles.	October		November	
	1918.	1917.	1918.	1917.
Batteries	$ 276,730	$ 275,721	$ 350,162	$ 409,968
Carbons	114,991	127,271	211,191	94,699
Dynamos or generators	254,156	196,146	300,230	202,046
Fans	15,679	29,276	35,307	33,361
Heating and cooking apparatus	86,144	63,840	54,617	48,596
Insulated wire and cables	525,031	306,713	398,956	713,533
Interior wiring supplies, including fixtures	83,656	100,345	153,310	241,265
Lamps—				
Arc	273	737	274	732
Carbon-filament	5,758	18,023	14,845	7,541
Metal-filament	191,344	240,686	423,533	285,814
Magnetos, spark plugs, etc.	222,099	283,272	260,796	433,704
Meters and measuring instruments	83,674	80,689	219,620	128,869
Motors	1,147,159	546,255	925,171	621,845
Rheostats and controllers	30,281	23,343	63,048	10,783
Switches and accessories	124,720	82,782	206,828	219,302
Telegraph apparatus, including wireless	19,689	16,609	51,767	24,099
Telephones	148,312	210,276	188,429	228,554
Transformers	206,575	224,975	554,116	271,016
All other	1,324,121	1,326,014	1,765,052	1,436,257
Total	$4,860,392	$4,152,973	$6,177,252	$5,411,984

For the first 11 months of 1918 the total electrical shipments were $54,794,545, as compared with $49,542,599 for the corresponding period of 1917, and $35,497,238 for the same eleven months of 1916.

NEW YORK MERCHANTS OPPOSE GOVERNMENT OWNERSHIP.

Recent Report by Special Committee Points Out Evils of This System.

The Merchants' Association of New York City recently reaffirmed its position in opposition to government ownership and operation of public utilities and declared emphatically in favor of private ownershipunder government regulation. This declaration was made in accordance with the recommendation of a special committee consisting of Frank R. Chambers, chairman; James G. White, Otto H. Kahn, Francis H. Sisson, H. H. Porter and Prof. Joseph French Johnson. The committee was appointed by President W. F. Morgan in pursuance of action taken by the board of directors for a re-examination of the question of government ownership and operation in view of the prominence that the matter has assumed since the beginning of the war.

The report of this committee constitutes a very clear and able presentation of the apparent evils of government ownership as evidenced by past performances.

Except under war conditions the sole plea that can be advanced to justify the operation by governments of public utilities is that governments can provide better service at less cost to the public than can private operators—that is to say, that government operation is more efficient and less costly than private operation. The general belief is that this contention cannot be sustained. On the contrary, it is contended that the operations of governments in the economic field, and particularly under American conditions, are generally characterized by inefficient management and excessive cost; so that under government operation the public would get poorer service and pay more for it than under private operation suitably regulated.

The success of any economic undertaking depends in very large degree upon the ability and skill, the zeal and energy, and the soundness of judgment of the human agents employed therein. Frequent change and unfitness in the higher ranks, and lack of opportunity and zeal in the lower ranks are dominant and inevitable features of political management. Those places are the rewards of political service, and the appointees, while perhaps proficient politicians, are seldom proficient business executives. Lack of opportunity in the lower ranks of the public service has a deadening influence upon the zeal and energy of the entire body of minor officials and the clerical staff as the higher offices with their larger salaries, being usually bestowed as rewards for political services, are seldom open to minor officials and clerks.

There are numerous other causes of disability from which those having direction of a business undertaking under government operation cannot escape and which make a high standard of efficiency impossible.

The managing official of a government undertaking is invariably hampered by undue and severe limitation of his discretion. He can do only those things which he is expressly authorized by law to do; he cannot exercise any power outside the limits prescribed by the law and is, therefore, to a large degree deprived of the power of initiative, a quality indispensable to high executive efficiency in business matters. Such an executive has no sufficient control of the organization under him. He cannot control appointments (except of his immediate subordinates and

not always those), nor methods of operation. He hasn't necessary power as to outlays. The funds needed for effective operation are usually limited by budget allowances based upon estimates made long previously, before the actual needs are fully known. Hence the executive is unable promptly to do that without which the business must suffer.

In the case of a business undertaking under private control and good management, funds for improvements which will conduce to economy are promptly provided. In the case of public operation, the pleas of executive officials are seldom considered upon their merits alone. Frequently the most convincing demonstration of the soundness of the proposed outlay fails to secure the much-needed appropriation.

This condition bears most heavily upon departments which operate physical plants, in the case of which considerable expenditures for extensions, betterments and maintenance are necessary to effective performance. An appropriating body can most readily keep down the public outlays by withholding appropriations for the purposes indicated. It is generally argued that there is no hurry about the matter; that the extensions and betterments can be deferred for two or three years, and that there is no need to spend much money for maintenance until the plants have become definitely unserviceable. Hence, the instances are extremely rare where under public control sufficient capital investments and outlays for maintenance are made to keep the plant up to its proper operating efficiency and to enable it fully to provide the service contemplated.

There are other influences of great potency which tend to limit the appropriations without which the public business cannot effectively be carried on. When any considerable new outlays are contemplated, particularly for such a public enterprise as providing electricity, gas or street-railway service, those outlays are invariably the subject of prolonged and frequently bitter public discussion, usually with violent opposition by a considerable part of the community. This opposition is directed to keeping down the public outlays without much regard either to the real needs of the business enterprise or to the fact that the proposed outlays would really result in very material economies of operation and decided improvement of service to the public. The result of this condition, under which political forces rather than sound business reasons prevail is that public service plants publicly operated are frequently starved by reason of the failure or refusal of the public officials to approve the outlays, without which a high degree of efficiency cannot be maintained nor adequate service supplied.

There are in America apparent exceptions to the general rule of municipal inefficiency, but they are only apparent and not real. Seemingly excellent showings are frequently made. These usually cover only a short initial period. They generally only cover obvious current costs and omit important factors of future costs. Loss in taxes, interest on investment, depreciation, amortization, extensions and betterments, rents and maintenance of public buildings whose costs are borne by other departments are commonly ignored. By these omissions an apparently favorable financial showing is made, while a true accounting would show the reverse. As a result of their disillusioning experience several hundred American municipalities have discontinued their attempts to save money by carrying on a business undertaking through the machinery of politics.

It is often proposed that the public should itself construct and own the physical plants of public utilities and secure their operation by contract with an operating company, in order to avoid the assumed evils of overcapitalization and secure a revenue for the public in the form of rentals or a share in the profits. It is further contended that this plan would avoid the evils of political control and secure the greater efficiency which is the result of private enterprise and business methods.

These contentions have little weight. The practice of overcapitalization with its evils, whether actual or assumed, has been practically abolished by the operation of existing laws enforced through railroad and public service commissions. Except in possibly a few states, securities can no longer be issued except with the approval of regulatory public bodies.

There are, in addition, serious objections to government ownership which seem to limit its utility and make the desirability of its general adoption questionable. Among these objections is the fact, as shown by the experience of nearly all state-owned railroads, that the cost of construction by governments is usually materially greater than the cost of similar work by private enterprise. In its effect, the result of this greater cost is precisely the same as the effect of an over-issue of securities or stock watering.

In conclusion, the report contained the following statement relative to private ownership: "While we are not unmindful of the defects that not frequently characterize the operation by corporations, of public utilities, we do not believe that those defects can be cured, by substituting another method which in every respect of efficiency is much below the standards that generally prevail under private management. In so far as the evils which are popularly assumed to exist in private management are found to exist in fact, other remedies than the substitution of methods abounding in greater evils should be found.

"We believe that the public can best be served by utilizing the efficiency, enterprise and energy of private corporations for the continued operation of public utilities, under such public control as shall protect the public in its right to efficient service and fair rates, and at the same time assure to private capital invested in public utilities a fair return upon such capital."

BALDWIN ON THE BATTLEFIELDS OF FRANCE.

New York Electrical Society Hears Forceful and Well Illustrated Address.

Members and guests at the 370th meeting of the New York Electrical Society listened on Jan. 27, to a most instructive and vivid description of the battlefields of France by Arthur J. Baldwin, vice-president of the McGaw-Hill Publishing Co., of New York. Mr. Baldwin was a member of the delegation of American technical editors, who, as guests of the British Government, visited not only the battlefields but many other scenes of devastation. He had just recently returned. Even the excellent set of photographs, shown in lantern slides, Mr. Baldwin said, could give only a slight conception of the destruction and desolation. Although Mr. Baldwin is a finished and unusually forceful speaker, he said that all the words he could call to his command seemed useless in attempting to convey his impressions. Nevertheless, his listeners were abundantly repaid and grateful to Mr. Baldwin.

Commercial

Central-Station "Brighten-Up" Campaign—Electric Smelting on Coast — Economy of Motor for Compressor Drive

REMARKABLE RESULTS OBTAINED IN "BRIGHTEN-UP" CAMPAIGN.

Sign Sales Greatly Increased During Past Month—Methods of Keeping Up Enthusiasm.

The recently organized movement to brighten up for the returning soldiers is now well under way, and the results so far are very satisfactory. Many merchants, chafing under the war-time restrictions and realizing for the first time the tremendous value of display lighting have eagerly accepted the suggestion of the local central stations to provide an added brilliancy for the returning boys and stimulate business at the same time. This has resulted not only in the sales of a great many signs and additional show-window lighting but also in a noticeable increase in the burning hours of existing lighting and signs and the repainting, relamping and repairing of many old signs.

IT'S TIME TO
BOOM BUSINESS OVER HERE!
THE WAR is over and we've won. Lightless nights have been done away with by the National Fuel Administration. The purpose of lightless nights was not alone to save coal but the Government felt that the darkening of Electric Signs offered the best means of quickly and visibly bringing home to the people the fact that the nation was actually at war. It is fitting, therefore, that darkness, gloom, depression and pessimism be abolished in favor of good cheer, bright lights, more business and optimism. The Electric Sign is the harbinger of good cheer, healthy business and of general prosperity. Let's get things going full speed ahead on a solid, substantial peace basis. Burn your Electric Sign. Give our boys a glad welcome upon their return home.
BRIGHTEN UP for the BOYS COMING HOME
Burn Your Electric Sign
RUGS
FURNITURE
ELECTRIC LAUNDRY
GARAGE
THEATRE
STATE BANK
RESTAURANT
Clothing
FLORIST
CANDIES
DIAMONDS
SODA
DRUGS
Light Your Show Windows
Use your Electric Sign with its scintillating, brilliant message to help stimulate the true spirit of victory—to aid in promoting your own business and national prosperity—to assist in creating new jobs for the boys when they return. Have your sign re-painted and re-lamped. If you haven't an Electric Sign call Randolph 1280, Local 218, or send in the post card enclosed and our representative will call with full particulars. We are enclosing two streamers for pasting on your show windows to spread the gospel of good cheer and good business. Have them pasted on your show window. If you want more, ask us to send them.
Telephone Randolph 1280—Sign Division
COMMONWEALTH EDISON COMPANY
EDISON BUILDING, 72 WEST ADAMS STREET, CHICAGO, ILLINOIS

Attractive Plugger Circulated by Chicago Central Station to Stimulate Sign Sales.

In order to keep this enthusiasm at its highest pitch the Commonwealth Edison Co. of Chicago, one of the first companies to realize and take advantage of this opportunity, has supplemented its newspaper advertising along these lines with a series of attractive circulars which are mailed out to its customers, together with printed cards for replies. All these circulars, one of which is reproduced herewith, lay particular stress upon the fact that plenty of light makes surroundings more cheerful, more welcome and more inspiring and serves to attract trade to the merchant. Streamers are also inclosed which are suitable for placing in the show window or other parts of the store bearing the slogan, "Brighten Up for the Boys Coming Home."

These circulars and the advertising campaign recently carried on by this company in the Chicago newspapers, coupled with an intensive selling effort by the company's salesmen, under O. R. Hogue, resulted in the sale of 72 signs during January of this year. Comparing this remarkable result with the total of 14 signs sold during January, 1918, it is evident that the opportunity for the sale of electric signs is greater now than it has been at any time in recent years.

FORCING YIELD OF OIL WELLS BY ELECTRIC HEATING.

The yield of an oil well may be diminished, and in some cases stopped, by the cooling of the rock-beds due to ingress of air. The crude oil is thereby thickened and its flow through the crevices and porous channels in the beds is checked or wholly arrested. The remedies commonly used are hot water, steam or hot air. These, however, are effective for only moderate depths. The recently devised method of applying an electric current to the warming of the oil avoids this difficulty, and, moreover, offers special advantages. The oil is heated without loss and, much gas being generated, a pressure is set up which in some cases has forced the oil to the surface in boreholes of great depth. The system is as effective in wells a thousand meters deep as in those of little depth. The military commands used the system of electrical heating to restore to working order temporarily abandoned mines in Galicia and Roumania.

VACUUM CLEANERS FOR TRAMCARS.

Vacuum cleaners are used by the Cleveland (Ohio) Railway Co. to clean car interiors prior to painting and varnishing and to remove dirt from motor frames prior to overhauling. A stationary turbine cleaner serves suction headers from which depend drop lines reaching to within 7 ft. of the floor; a minimum length of flexible hosing thence serves any part of the car shop. When it is required to clean motors, the latter are placed over a floor-grating (through which suction is maintained), and covered by a canvas hood. Dust, etc., is loosened by an air-blast and removed by suction; heavy particles are retained by the cleaner and dust is washed into a settling basin under the shop floor by a water spray in the eliminator. The equipment is designed to facilitate access to awkward places and its use permits work to be done more thoroughly

ELECTRIC SMELTING PRACTICE ON PACIFIC COAST.

Ferro-Alloys Require Cheap Power—Acid and Basic Processes—Furnaces Used—Amount of Power Required.

W. L. Morrison, plant superintendent of the Western Reduction Co., Portland, Ore., presented the following on "Electric Smelting" at the recent joint meeting of the Portland Sections of the National Electric Light Association and American Institute Electrical Engineers.

Electric smelting, aside from the steel and iron industry, is a new industry in the Northwest. At the present time there are plants located as follows: Pacific Electro Metals Co., Bay Point, Cal.; Noble Electric Steel Co., Heroult, Cal.; Western Reduction Co., Portland, Ore.; Bilrowe Alloys Co., Tacoma, Wash.; Seattle Smelting Co., Seattle, Wash. These plants, until very recently, were all producing ferro-manganese in some form or other. Ferro-chrome, ferro-tungsten and ferro-molybdenum have been produced to some extent on the Pacific Coast, but at the present time I do not know of anyone carrying on operations. However, some of the plants are contemplating the manufacture of the above alloys.

Cheap power is one of the big factors which attract electrochemical industries. With very few isolated cases we have no cheap power on the Pacific Coast today for electrochemical manufacture. When the cost of power becomes a large part of the manufacturing cost, in order to meet competition we must have competitive rates. For example, the power used in the production of ferro-silicon is so great per ton of metal produced that a difference of one mill per kilowatt-hour increase in power rate above what other manufacturers are paying, would put you out of business, other things being equal.

In the case of electric steel furnaces the variation of a few mills per kilowatt-hour makes very little difference, for there is used only 600 to 800 kw-h. per ton of steel, while in the cases of ferro-silicon we use 7000 to 9000 kw-h. per ton of metal; moreover, electric furnace steel sells at a higher price than ferro-silicon. The same may be true with other ferro-metals to a greater or less extent.

With the production of steel in the electric furnace I believe you are more or less familiar, for there has been an electric steel furnace operating in Portland for several years.

Manganese and chrome require very much the same kind of furnace for their production. The simplest form of furnace is the single-phase furnace, which consists of a large pot with a terminal in the bottom, either a water-cooled iron plug or a conducting hearth of carbonaceous material. A tap hole is placed at the bottom of the lined crucible for removing the molten metal and slag.

A carbon electrode is suspended in the pot, this forming the other terminal which is movable to regulate the current in the furnace. Various modifications of this furnace are used, depending on the size of installation, the more common type being the three-phase furnace in which three or six electrodes are used.

There are two practices followed in the smelting of ores which are called the acid and basic, with some slight modifications. To those who are not familiar with the terms "acid" and "basic" processes, I will give a word of explanation. These terms refer to the condition of the slag during the smelting operation. The acid slag is one in which the silica predominates, making a glassy slag. In the case of the basic slag, lime, iron, magnesium or some other such bases are present in such greater quantity as to more than neutralize the silica (acid). If the bases are in such quantity as to just neutralize the silica, the slag is termed a neutral slag.

The linings of the furnace should be such as are not readily attacked by the slag employed. For example, an acid slag requires a silica lining; for a basic slag a magnesite lining is used. When the operation is such that a carbon lining will not contaminate the product, then this kind of lining is to be preferred, as it will stand up very well under either acid or basic conditions.

Both methods of smelting are followed in the production of ferro-manganese. The extreme acid practice (i. e., when little or no lime is used) gives a high silicon and low carbon content in the ferro-manganese, which before the war was imported from France to some extent.

The basic process in the production of ferro-manganese gives a lower silicon and higher carbon content. This is the more common form of ferro-manganese on the market. In the production of ferro-chrome, the same holds as in the case of manganese, except in case of the higher grades, or so-called low-carbon ferro-chrome products.

The production of tungsten and ferro-molybdenum is carried out in a somewhat different way from that of manganese and chrome on account of their high melting points when nearly pure. The common alloys run from 70 to 85% tungsten or molybdenum.

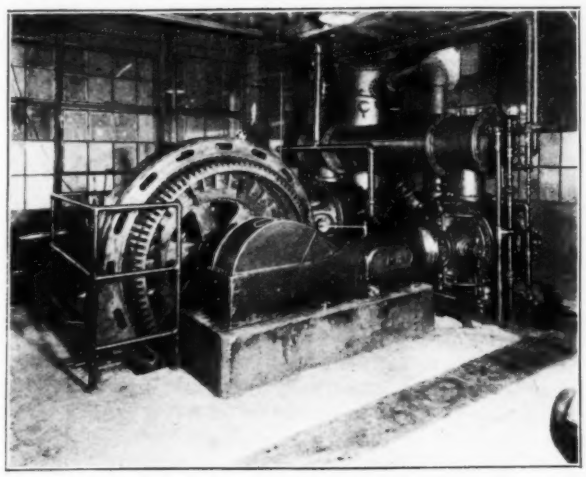
The process for producing the ferro is almost universally carried out in a single-phase furnace, or pot, averaging from 25 to 100 kw., the commonest size being about 50 kw. These furnaces operate with the single electrode. The pots vary in size from 10 in. inside diameter up to 24 in. and from 24 in. to 36 in. high. The pots are placed on large terminals, either of iron or carbon material. After the operation is completed the pots are removed and new ones started.

The metal is allowed to accumulate in the pots by tapping the slag from time to time through an opening punched in the lining of the pot at the top of the metal. The ore and flux are charged into the pot intermittently after the tapping of the slag. At the end of the operation, when the pot has become too full for economic operation, it is removed and broken open, the button of metal being removed and crushed. The weight of the buttons varies from 500 to 3000 lb.

One ton of tungsten or molybdenum requires 8000 to 10,000 kw-h. per net ton of metal. One net ton metallic chrome (60-70%) alloy requires 10,000 to 14,000 kw-h. One long ton 80% ferro-manganese requires 3500 to 5000 kw-h.

ELECTRICS ENDORSED BY AN IMPORTANT RAILWAY COMPANY.

The fact that the Midland Railway Co. of England employs 55 electric vehicles in London alone is a testimony to the efficiency of this type of motor vehicle for use on circuits of moderate distance, permitting their being sent out of and being brought into the yards with fairly heavy loads, but requiring the making of frequent calls for collection and delivery purposes. Under such conditions petrol vehicles do not show to advantage, the fuel consumption and wear of working parts being out of all proportion to the work done.



Motor-Driven Air Compressor in Detroit Metal Plant.

SYNCHRONOUS MOTOR PROVES ECONOMICAL FOR COMPRESSOR DRIVE.

Compressor Set of 260 Hp. for General Aluminum & Brass Manufacturing Co., Detroit.

By Harry Dean.

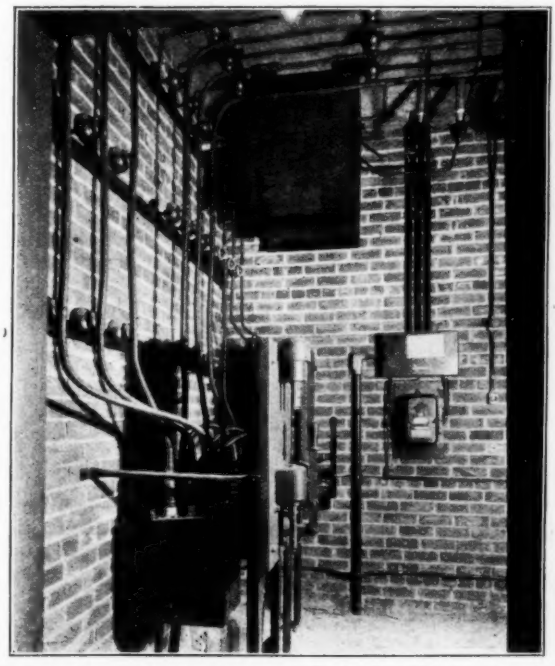
The accompanying illustrations show the high-voltage service, switches, the control switchboard, and the motor-driven air compressor recently installed in the plant of the General Aluminum & Brass Manufacturing Co., of Detroit, Mich. The addition of this machine was made necessary by the large amount of war material manufactured by this company. Some idea of the growth of this company can be gained when it is stated that just a little over three years ago it installed its first 100-hp. compressor; now it has a total of 480 hp.

In line with other Detroit firms that use large amounts of compressed air it was decided to install a synchronous motor to operate direct from the 4600-volt power supply line. This improves the power-factor of the whole plant and saves the cost of three step-down transformers and their losses. For these reasons it is more economical to run this new machine than one of the smaller ones, even on light load.

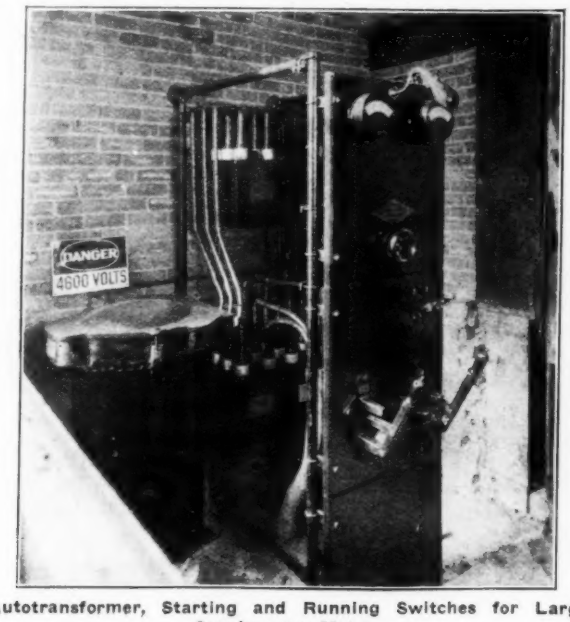
The compressor was made by the Ingersoll-Rand Co. It delivers 1800 cu. ft. of air per minute at 100 lb. pressure. A great improvement over the 100-hp. machines is the automatic regulator by means of which the machine can be made to deliver one-quarter, one-half, three-quarters, or full load.

Circulating water for cooling the compressor is obtained in a very economical manner. As the city water pressure is not great enough for fire protection, a high water tank was installed in connection with the sprinkler system in the plant. Circulating water for cooling the compressor is taken from this tank and then returned to the tank by means of the pump, part of which is shown at the left of the compressor. In this way the same water is used over and over again.

The motor is 260 hp., 4600 volts, 225 r.p.m., and built by the Electric Machinery Co., Minneapolis, Minn. The oil switches were made by the Condit Electrical Manufacturing Co., South Boston, Mass. The motor is started by means of a reduced voltage, which is obtained by using an autotransformer made for that purpose by the Kuhlman Electric Co., Bay City, Mich.



4600-Volt Service Switch House. Each Switch Has Overload Relay.



Autotransformer, Starting and Running Switches for Large Synchronous Motor.

Power is purchased from the central-station system of the Detroit Edison Co. This allows the manufacturing company to devote all its time and energy to the manufacture of its varied line of products, consisting of "Ring True" bearings, aluminum and white-metal die-castings, and brass and aluminum sand castings.

MUNICIPAL PLANT FORCED TO RAISE RATES.

The United States Reclamation Service, which has been supplying electricity to Williston, N. D., has submitted a new contract for acceptance by that city of 25% higher rates paid than heretofore. The city must either pay the increased rates or do without electricity.

Operating

Effect of Impregnating Coils of Railway Motors—Transmission Line Clearances—Wash out of Cable Duct Line

DIPPING AND BAKING RAILWAY MOTORS.

Operating Data Over Thirteen Years Proves Benefit.

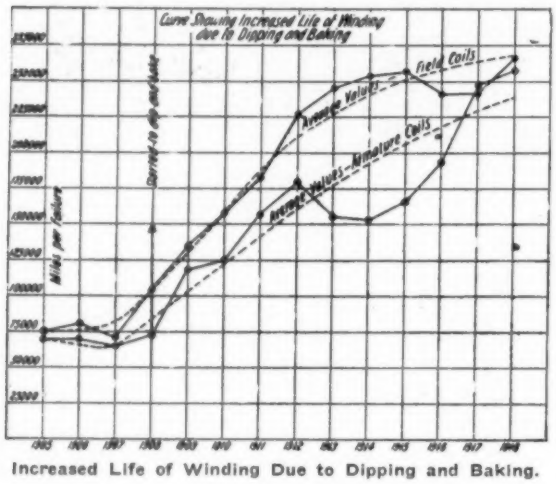
J. S. DEAN
Westinghouse and Electric Mfg. Company.

A striking example of what can be accomplished in the way of prolonging the life of railway motor windings by dipping and baking is shown by the curves with armature and field failures per car miles, plotted against each year's record over a period of 13 successive years.

Referring to these curves, it will be noted that during the year 1908 there was a decided upward trend of both curves, which is due to the fact that at this time the master mechanic in charge of this property instituted a regular and systematic schedule of dipping and baking the windings of his motors as follows: Every 1½ to 2 years (approximately 60,000 to 75,000 miles) during the general overhauling period the field coils and armatures are given a dipping and baking. Should motors be in the shop for other repairs, and if windings appear dry, although they have not made their allotted mileage, they are given an extra treatment at this time.

Dipping and baking the motor windings on this property has produced the following beneficial results: Fewer crippled cars, less repair work, more reliable service, favorable public opinion.

The curves show 265,000 miles (7 years' service)



Increased Life of Winding Due to Dipping and Baking.

per failure, when dipped and baked, and 75,000 miles (2 years' service) per failure, when not dipped and baked; 3½ failures (no treatment) to 1 failure (treated) in 7 years, which is 2½ failures saved by dipping and baking in 7 years.

On 300 motors this is equal to 300 × 2½ or 700 failures in 7 years, which is the equivalent of 100 failures in 1 year.

Approximate cost to dip and bake is $2 per motor, and as each motor is treated every 1½ years, then we have 300 × $2 × ⅔ = $400, cost per year; saving $2350 per year; estimated cost to install plant $1200, which shows a net saving of $1150 the first year, and a saving each succeeding year of $2350.

BREAKING HYDRAULIC MAIN WRECKS UNDERGROUND CABLE DUCTS.

Interesting Accident Destroys Cables and Concrete Duct Line.

Recently in London a water main at 720 lb. pressure burst during the night, due to a slight subsidence of the soil.

Usually defects in hydraulic mains are at once evident from the water bursting through the road surface, but in this instance, owing to the sandy nature of the subsoil, the water dispersed in all directions underground, the first indication of the leakage being the escape of large quantities of water into the basement of an adjacent warehouse. The burst occurred in close proximity to a manhole, and considerable damage was done before the water was turned off.

The work of repair was immediately taken in hand and the ground excavated down to the ducts in order to ascertain the full extent of the damage. Water at the very high pressure of 720 lb. per sq. in. had been escaping for a considerable time, and the cable ducts, 3 ft. below the hydraulic main and 10 ft. below the surface of the road, had been subjected to the full effect of this enormous pressure. A jet of water accompanied by stones and debris had formed a veritable subterranean "sand blast," and had worn away concrete ducts and cables to the extent that a huge cavity was made in the road and the adjacent manhole was partially choked with debris forced through the broken ducts. A number of the cables were pounded into an unrecognizable mass. Some of the stones which helped to beat the structure to pieces, were themselves worn quite round and smooth in the process.

It was discovered that, owing to the high pressure of water, soil and stones had filled the square ducts in some cases to a distance of nearly 100 ft., and stones of the same diameter almost as the ducts were found 80 ft. from the point of breakage. These stones had to be worked out with infinite patience, as any attempt to push them out with rods resulted in their becoming jammed again. When the stones had been removed, the soil was cleared by means of endless ropes and chains passed through the ducts like conveyor belts. Brushes and mops were used in the final stages. The work of clearing was consequently slow. All the well-tried devices were brought into use.

At the outset it was intended to draw new cables into spare ducts adjoining the faulty ones, but the spare ducts being completely choked, it was decided to cut the cables and draw out the faulty sections

and use the ducts thus cleared. This was a very tedious operation, as the cables were tightly wedged in with stones, but after much effort had been expended, incidentally resulting in the breakage of several heavy ropes, the one adopted met with success. New cables were then pulled. In all, sixteen ducts were broken, and three cables damaged.

CLEARANCES OF TRANSMISSION LINE CONDUCTORS.

Methods of Determining Conductor Clerances.

Considerations affecting the clearance between conductors are mechanical and electrical. The former deals with the possibility of wires swinging dangerously close together, the latter the possibility of corona loss.

The possibility of wires swinging together depends upon the relative position of conductors, whether horizontal, vertical or triangular. Wind may blow at any angle to the conductors, and with different velocities at different points in any span; hence a set of sagging conductors of small weight relatively to their wind area (for instance, very small wires, especially if of light material such as aluminum) will tend to swing irregularly, that is, out of phase, and might touch or come dangerously close unless well spaced. Wires having a greater weight relatively to their wind area (large wires, especially of heavy material such as copper) will have a more dead-beat action and will tend to swing less out of phase, and consequently need not be spaced so far apart to obtain the same security against short-circuits.

This out-of-phase swinging is best stated as an angle, and as the wires cannot very well swing to diametrically opposite positions, the maximum angle of out-of-phase swinging for the lightest and smallest wires will be, suppose, 90°. For heavier, larger wires the angle will be less. This ratio, however, may also be expressed as an angle made with the vertical by the resultant of the wind load and weight. The maximum value of this angle would also be 90° for the hypothetical case of a wire with no weight, and the heavier and larger the wires the smaller will be the angle. From this point of view, the relationship of wind area to weight might be used as an absolute indication of clearance by making the latter equal to the product of the sag and the sine of the angle made with the vertical by the resultant of the wind area and the weight.

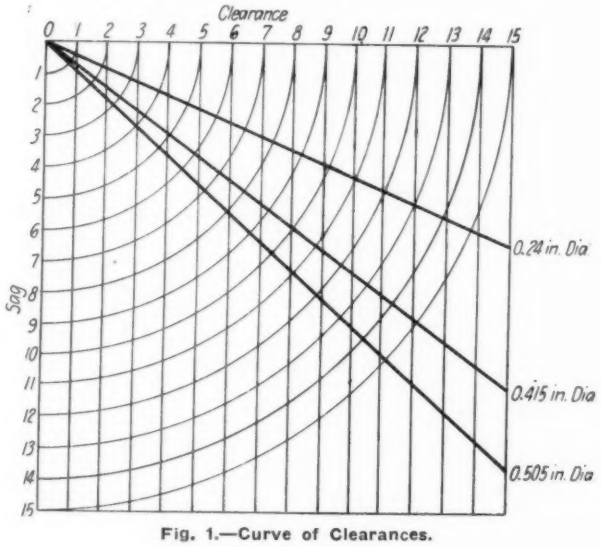


Fig. 1.—Curve of Clearances.

To prevent swinging together, clearances must obviously vary with the tension at which the conductors are strung, also with the span, the wind, the temperature, the size and material of the conductor,

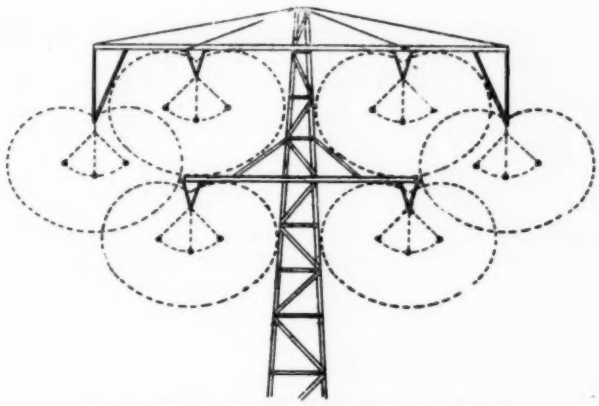


Fig. 2.—Clearances With Suspension Insulators.

and the sag, and all these conditions are considered in this method.

The accompanying curve of clearances has been calculated by G. V. Twiss upon this basis and appears to give clearances which are comparable with the best practice. A further discussion of this matter will be found in a paper, "High-Tension Overhead Transmission Lines," by G. V. Twiss before the I. E. E.

The chief point to be taken into consideration in determining the clearance with the vertical arrangement is the possibility of the wires being unequally borne down by ice or snow, or of the wind lifting or depressing the wires unequally. The clearance will therefore bear a relationship to the span, and a clearance of 1 ft. per 100 ft. of span would appear to be a good rule.

The clearance with the triangular arrangement, if the base of the triangle is horizontal, would be settled as above for horizontal clearance; if vertical, then the vertical clearance would settle it, and for all other cases the clearance could be adjusted accordingly.

In regard to the electrical considerations, formulas are already available.

The final clearance chosen for a given case would be whichever proves to be the greater, that indicated for electrical or for mechanical considerations; and in certain cases the necessary clearance between the conductors and the pole may necessitate a greater clearance between the conductors than that above obtained.

As suspension insulators swing out of the vertical the conductor may come close to the cross-arm and thereby reduce the clearance as measured from the conductor to the cross-arm over the insulator. In order to maintain this clearance the sling previously referred to has therefore been used. Fig. 2 shows a mast with these slings and the clearances thereby obtained. As a matter of fact, however, on the majority of transmission lines where suspension insulators have been adopted no such refinement has been used for the purpose of maintaining this clearance, and it is evidently considered that trouble from this source is so unlikely as not to justify special provision to prevent it. This theory is largely justified by the fact that an arc would always tend to strike in the path of the strongest electrostatic field, which would generally be that over the insulator.

Contracting-Construction

Recommended Practice in Wiring Squirrel-Cage Motors—Insulated Screw Driver—Illinois Contractors to Convene

WIRE AND FUSE SIZES FOR INDUCTION MOTORS.

Report of Committee on Installation and Operation of Induction Motors Presented Before Western Association of Electrical Inspectors.

One of the most valuable reports presented at the fourteenth annual convention of the Western Association of Electrical Inspectors held in Chicago last week was the report of the Committee on Installation and Operation of Induction Motors, of which K. W. Adkins is chairman. This report is a revision of the 1917 report submitted by the same committee at the Toledo convention of the association and reprinted almost in full in the ELECTRICAL REVIEW AND WESTERN ELECTRICIAN of Feb. 3, 1917. The table given in that report aroused a great deal of interest among our readers at the time. In the following, the new report is given in slightly condensed form and it will be observed that the large table has been revised to conform to the latest (1918) edition of the National Electrical Code.

The principal Code rules that relate to motor wiring are 8*b*, fifth and sixth paragraphs; 8*c*, fourth and fifth paragraphs. In the majority of cases, where alternating-current motors of the type requiring large starting current, such as squirrel-cage induction motors, are thrown directly across the line or started by means of autostarters, the current-carrying capacities of wires meeting the rule will not exceed the percentages of the full-load currents of the motors as given in the table at the end of 8*b*.

The first portion of fourth paragraph of Rule 8*c* applies only to the size and rubber-covered conductors used with alternating-current motors taking large starting currents. The size of fuse or other protective device, of course, depends entirely on the starting characteristics of the motor. The rules take the protective device as the starting point in determining the size of the wire and permit the wire to be selected on the basis that its carrying capacity is in accordance with Table B, of Rule 18.

Switches should have a rated capacity at least as large as the rated capacity of the fuse protecting the circuit, or if the circuit is protected by a circuit-breaker, the switch should have such capacity that the breaker will be set to be opened by a current not greater than 30% in excess of the current rating of the switch.

Apparently, it is the intent that the rules should be interpreted to differentiate between motors taking large starting currents, such as the squirrel-cage type of motor, and types which do not take large starting currents, such as the wound-rotor slip-ring type of motor. Therefore, wires supplying a motor of the latter type can safely be selected on the basis that they are to carry a current only 10% greater than the rated capacity of the motor, as the starting current values are not excessively high, they are of short duration and infrequently applied.

As there is no fixed ratio that may apply to current values in stator and rotor circuits of the wound-rotor slip-ring type of motor, the manufacturers are now indicating on name-plate rating of motor these current values. It would seem reasonable to recommend that in selecting wire size for leads between resistance grids and slip-rings, where rubber-covered conductors are used, that same may safely be selected from Table B of No. 18, as the leads are not long and the current flow is of short duration.

The wire sizes given in the large table are calculated in accordance with the Code rules and should apply primarily for wiring to alternating-current squirrel-cage induction motors, which are started by autostarters, or compensators or motors having similar starting characteristics. Where motors are not started by means of approved autostarters or slow-speed motors (less than 600 r.p.m.) are used, wire or cable one size larger than size given in this table will, in the majority of cases, meet the requirements of the rules.

The current values used in the table are the average current values of motors of different types, frequencies and standard speeds, and a variation of 10% higher or lower may be expected. The question of drop is not taken into consideration in these tables.

Where alternating-current squirrel-cage motors are started by the star-delta scheme, wire size should be calculated from data given in the first or small table, and wire selected from Table A or B of No. 18, according to insulation, except that rubber-covered conductors may be protected by fuses or an automatic circuit-breaker without time-limit device, rated in accordance with Table B of No. 18. For motor protec-

DATA FOR DETERMINING SIZE OF WIRE OR CABLE FOR A SINGLE MOTOR.
Continuous Duty (Constant-Speed Motors).

Type of Motor and Method of Starting.	Approximate Starting Current in % of Full-Load Current.	Multiplying Factor to Determine Size of Wire or Cable.
A. C. squirrel-cage induction without compensator, 7½ hp. or less	500 to 600%	3.0 × full-load current
A. C. squirrel-cage, Star-Delta starting	150 to 200%	1.5 × full-load current
A. C. squirrel-cage induction with auto-transformer or compensator	100 to 430%	For 0-30 amperes full-load current, 2.5 × full-load current Above 30 amperes full-load current, 2.0 × full-load current
A. C. induction motors with resistance in rotor circuit for starting	100 to 125%	1.1 × full-load current
A. C. single-phase repulsion (repulsion-induction), 15 hp. or less	225 to 300%	2.0 × full-load current
A. C. single-phase induction split-phase starting, 10 hp. or less	500 to 550%	3.0 × full-load current

FUSE AND WIRE SIZES FOR INDUCTION MOTORS OF SQUIRREL-CAGE TYPE OR SIMILAR TYPES TAKING LARGE STARTING CURRENTS.

INDUCTION MOTORS—SINGLE PHASE—All Frequencies and Standard Speeds

	Full Load Amps.				Starting Fuse Amps.				Running Fuse Amps.				Size of Wire or Cable Rubber or Other Insulation			
H. P.	110V	220V	440V	550V	110V	220V	440V	550V	110V	220V	440V	550V	110V	220V	440V	550V
.5	6.8	3.4	1.7	1.3	20	10	5	5	10	5	5	5	14	14	14	14
1	13.3	6.6	3.3	2.4	35	20	10	5	15	10	5	5	8	14	14	14
2	24.8	12.4	6.2	4.9	65	35	20	15	30	15	10	5	6	8	14	14
3	36	18	9	7.2	75	45	30	25	40	20	15	10	4	8	10	12
5	58.4	29.2	14.6	13.8	120	70	40	30	65	35	20	15	2	6	8	10
7.5	85.2	42.6	21.3	17.1	170	85	55	45	95	45	25	20	0	4	6	8
10	110	55	27.5	22.4	220	110	70	60	120	60	30	25	00	2	6	6
15	162	81	40.5	33	325	165	80	70	180	90	45	35	211,600	0	4	6
20	208	104	52	42.6	400	200	110	85	230	115	60	45	300,000	0	2	4
25	258	129	64.5	51.6	500	260	135	100	280	140	70	60	400,000	000	1	2
30	304	152	76	61	600	300	150	125	335	170	85	70	500,000	200,000	0	2
35	356	178	89	70	710	360	180	140	380	190	100	80	650,000	300,000	0	1
40	400	200	100	80	800	400	200	160	440	220	110	90	750,000	300,000	0	0
50	492	246	123	99	980	590	250	200	540	270	135	110	1,000,000	500,000	000	0

INDUCTION MOTORS—TWO PHASE—FOUR WIRE—All Frequencies and Standard Speeds

	Full Load Amps.*				Starting Fuse Amps.				Running Fuse Amps.				Size of Wire or Cable Rubber or Other Insulation			
H. P.	110V	220V	440V	550V	110V	220V	440V	550V	110V	220V	440V	550V	110V	220V	440V	550V
.5	3.1	1.5	.8	.6	10	5	5	5	5	5	5	5	14	14	14	14
1	6	3	1.5	1.1	15	10	5	5	10	5	5	5	14	14	14	14
2	11	5.6	2.8	2.2	30	15	10	5	15	10	5	5	10	14	14	14
3	14.7	7.3	3.6	3.2	40	25	15	10	20	10	5	5	8	10	14	14
5	28.6	14.3	7.1	5.3	70	35	20	15	30	20	10	10	6	8	12	14
7 5	38.8	19.4	9.7	7.8	80	50	30	20	45	25	15	10	4	8	10	12
10	50.2	25.1	12.5	10.8	100	65	35	30	55	30	15	15	2	6	8	10
15	73.4	36.7	18.3	15	150	75	45	40	80	40	20	20	1	4	8	8
20	95	47.5	23.7	19.5	190	95	60	50	110	50	30	25	0	2	6	8
25	118	59	29.5	23.4	240	120	70	60	130	65	35	30	000	2	6	6
30	138	69	34.5	27.6	280	140	75	65	150	75	40	30	200,000	1	4	6
35	162	81.3	40.5	32	320	160	80	70	190	90	45	35	211,600	0	4	6
40	182	91	45.5	36.4	360	180	90	75	200	100	50	40	300,000	0	4	4
50	224	112	56	45	450	225	110	90	245	125	60	50	350,000	00	2	4
60	268	134	67	53.5	540	270	135	110	290	150	75	60	450,000	000	1	2
75	332	166	83	66.5	660	330	170	130	365	180	90	75	600,000	211,600	0	1
100	...	218	109	87.5	.....	440	220	175	.....	240	120	95	.....	350,000	00	0
150	...	320	160	128	.....	640	320	260	.....	350	175	140	.....	550,000	211,600	000
200	...	418	209	169	.....	830	420	340	.....	450	230	185	.....	800,000	350,000	300,000
250	...	515	257	207	.....	1030	500	400	.....	560	280	230	.....	1,100,000	400,000	300,000
300	...	615	307	246	.....	1230	600	500	.....	675	340	270	.....	1,400,000	500,000	400,000

*Value of current in common wire for a two-phase three-wire system would be 1.41 times value given.

INDUCTION MOTORS—THREE PHASE—All Frequencies and Standard Speeds

	Full Load Amps.				Starting Fuse Amps.				Running Fuse Amps.				Size of Wire or Cable Rubber or Other Insulation			
H. P	110V	220V	440V	550V	110V	220V	0V	550V	110V	220V	440V	550V	110V	220V	440V	550V
.5	3.6	1.8	.9	.7	10	5	5	5	10	5	5	5	14	14	14	14
1	7	3.5	1.75	1.3	20	10	5	5	10	5	5	5	14	14	14	14
2	13	6.5	3.25	2.6	30	20	15	10	15	10	5	5	10	12	14	14
3	19	9.5	4.75	3.8	50	30	20	10	25	15	10	5	8	10	14	14
5	30.8	15.4	7.7	6.2	70	40	25	15	35	20	10	10	6	8	12	14
7.5	44.8	22.4	11.2	9	90	60	30	25	50	25	15	15	4	6	10	12
10	58	29	14.5	11.8	120	70	40	30	65	35	20	15	2	6	8	10
15	85	42.5	21.2	17.4	170	85	50	40	95	45	25	20	0	4	8	8
20	110	55	27.5	22.5	220	110	60	55	120	60	30	25	00	2	6	6
25	136	68	34	27	270	140	70	65	150	75	40	30	000	1	6	6
30	160	80	40	32	320	160	80	70	175	90	45	35	211,600	0	4	6
35	188	94	47	37	375	190	100	75	210	110	50	40	300,000	0	2	4
40	210	105	52.5	42	420	210	110	85	230	115	60	45	350,000	00	2	4
50	260	130	65	52	520	260	125	110	285	145	70	60	450,000	000	1	2
60	310	155	77.5	62	620	310	160	125	340	170	85	70	550,000	211,600	0	2
75	384	192	86	77	770	390	175	160	420	210	95	85	750,000	300,000	0	0
100	...	252	126	101	.....	500	250	200	.....	280	140	110	.....	400,000	000	0
150	...	368	184	148	.....	730	370	300	.....	410	200	160	.....	700,000	300,000	200,000
200	...	484	242	195	.....	920	480	390	.....	530	265	215	.....	900,000	400,000	300,000
250	...	595	287	240	.....	1200	570	480	.....	650	315	265	.....	1,300,000	500,000	400,000
300	...	710	355	285	.....	1420	710	570	.....	780	390	315	.....	1,600,000	650,000	500,000

tion, when the above scheme of starting is used, the use of time-limit circuit-breaker or time-limit overload protective plugs is strongly to be recommended.

Wire sizes for intermittent-duty varying (or variable) speed motors, according to the Code, must be selected from Table A or B of No. 18, depending upon type of insulation of conductors and this does not permit, for this service, conductors having rubber insulation being protected by fuses, rated in accordance with Table B of No. 18.

The protection of conductors with fuses, rated in accordance with Table B of No. 18, is for the protection of the wires to the motor and is considered as giving ample protection from injury when fused according to this rule. However, the motor itself will not be protected by these larger fuses against very high current values of extremely short duration, moderately heavy overloads for long periods, and overloads on portion of stator windings due to motor operating single phase; therefore, it is customary to provide additional protective devices in the circuit, of proper rating to amply protect motor.

The Code requires that the motor and starting device be protected, and for ordinary continuous-duty service the motor may be protected by any one of the following methods: Overload protective relays, circuit-breakers, time-limit overload protective plugs and fuses. Time-limit circuit-breakers, fuses and similar protective devices rated 10% greater than that for which the motor is rated are considered as giving ample protection for motor and starting device.

For alternating-current motors of the varying (or variable) speed type, used in intermittent service, it is not so essential that additional protective devices be provided, as these motors are designed for an overload capacity of from 200 to 250% for short periods of time, and adequate protection is generally afforded these motors by fuses of per cent rating as given in the table at the end of Rule 8*b*, to be used with these types of motors for the several classifications of service.

The large table gives the wire size for supplying a single, continuous-duty constant-speed motor. In order to calculate the size of mains to supply more than one motor, the probable maximum current to be carried by such mains must be determined and, in the absence of any definite demand-factor, the only safe way in determining the size of mains is to take the sum of the full-load current of all motors supplied, plus the additional current required to start the largest motor supplied from such mains, and from this total select a wire size from Table A or B of No. 18, according to insulation. The Code does not permit conductors for mains, having rubber insulation, being protected by fuses, rated in accordance with Table B of No. 18.

For the usual factory conditions, the maximum current carried by mains is generally less than the sum of the full-load currents of the motors connected to the mains, as in most cases it would seldom occur that all motors would be carrying full-load current at the same time, and it might seem that a demand-factor should be considered. However, to determine the proper demand-factor would be an engineering rather than an inspection problem; therefore, no recommendations have been made by the committee. However, in case a demand-factor is considered, the size of wire for mains should be checked, to prevent error, by assuming the largest motor starting and all other motors running, allowing the per cent demand-factor of the full-load current of these motors.

In conclusion, in order to obtain uniformity in installation of alternating-current motors, the committee included a few specific requirements, as follows:

That each motor of ¼ hp. or over be provided with individual fuse protection.

That all motors above 5 hp. should be provided with approved starting devices, auto-starters or compensators.

Motors without compensators should be started by an approved switch, which must be provided with spring release on starting side, so it will remain in the starting position only when held there.

That the use of overload relays or time-limit circuit-breakers be recommended in lieu of fuses for motor protection in plants where care and adjustment is under competent supervision.

That properly rated protective devices, such as fuses, relays, circuit-breakers or time-limit overload protective plugs be required for all continuous-duty motors of 1 hp. and above.

Approved switches to be required in connection with autostarters, even though switch of autostarter disconnects all wires to motor.

When compensators of the type using two single-coil transformers on two and three-phase systems are used, the middle fuse on three-phase system on the "running side" may be omitted, and when this type of starter is used on a two-phase four-wire system, one fuse in each phase on the "running side" may be omitted.

Alternating-current motors of the repulsion-induction and slip-ring types should not be installed where subject to inflammable gases, or flyings of combustible materials, unless gas and dust-tight castings properly enclose commutator, or slip-rings of motor; or the motor should be properly enclosed in cabinet, or room, subject to approval of inspection department having jurisdiction.

GROUNDING OF SECONDARIES DISCUSSED AT PHILADELPHIA CONFERENCE.

Electrical Conference Holds Interesting Monthly Meetings to Educate on Improved Electrical Construction.

At the Jan. 30 meeting of the Electrical Conference held in the Engineers' Club, Philadelphia, Pa., a very instructive address on "Grounding of Secondaries" was delivered by W. J. Canada, formerly electrical engineer of the Bureau of Standards, Washington, D. C. He gave a general review of the conditions that led to the drafting of the rules on grounding in the National Electrical Safety Code and to the recent revision of the grounding rules of the National Electrical Code. The meaning of the various rules was explained and the entire subject covered in a comprehensive manner.

The Electrical Conference is a unique institution of Philadelphia that is now in its ninth year. It meets once a month, except during the hot summer months, to discuss problems connected with improvement of electrical construction. Membership is free to anyone interested in the subject. Special efforts are made to educate electrical contractors, their foremen and wiremen, architects, engineers, manufacturers, jobbers and inspectors, as to the meaning of Electrical Code rules and the reasons therefor. Best methods of electrical construction are freely discussed with the idea of bringing the entire electrical industry of the Philadelphia district to co-operate for electrical progress. Washington Devereux, president of the National Association of Electrical Inspectors, is chairman of the conference.

AN IMPROVED INSULATED SCREW DRIVER.

By J. A. Weaver.

Wiremen, and especially plant electricians, often have occasion to work on wiring devices and electrical apparatus while the parts are alive and a thoroughly insulated screw driver that can be depended upon is very desirable. The accompanying sketch shows the construction of an insulated screw-driver, that possesses several new and advantageous improvements in this direction. It can be made in any size to suit the individual requirements, or to utilize available materials.

The screw-driver blade can be obtained from one of regular wood handle pattern. The blades should not flare, but should be no wider than the diameter of shank, so the fiber tube will slip over it. The hole in the fiber handle in which the shank of screw driver fits, should be of such size that the shank will make a good driving fit, and it is further secured by a pin driven through it and the handle. This hole should be drilled after the handle has been driven on, and should be deep enough to allow the pin to be sunk well below the surface of the handle. The machine screw that serves for a guide pin and stop for the sliding tube should also be well countersunk, and the depressions filled with a plug of insulating material.

The form of slot in the sliding fiber tube is shown in detail in Fig. 2. The cross slot permits the tube

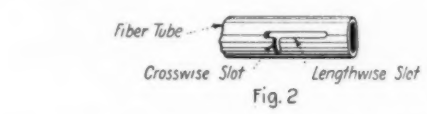


Fig. 2

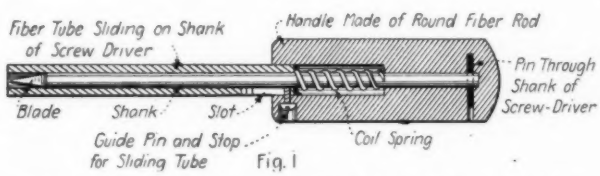


Fig. 1

Cross-section of Handy Insulated Screw Driver, Showing Method of Construction.

to be locked in position, up out of the way of the screw-driver blade when desired, by a slight twist of the fingers. The spring used should exert a fairly good pressure on the tube, the movement of which should be about ¾ to 1 in. After the tool is assembled, the tube should be cut off so that when it is fully extended, it will project about ⅛ in. beyond the screw-driver blade. When in use the sliding fiber tube is pressed against the head of the screw, and the only metal exposed is the portion of the screw-driver blade that is in the screw slot. The pressure of the tube on the head of screw tends to keep the blade centered in the slot.

This tool will enable the user to work on "hot" apparatus with a great saving in time, as there is no danger of causing a dangerous short-circuit or ground should the blade slip from the slot of the screw, or touch any exposed metal of opposite polarity. When working on a panelboard, or behind a switchboard with live buses, should it be accidentally dropped amongst the live parts it can cause no damage.

This screw-driver will be especially valuable to inspectors and others who must carry such a tool around with them but are put to considerable trouble by the sharp edges tearing their clothes. When the tube on this screw-driver is released to slip over the blade these edges are covered and this trouble eliminated.

ILLINOIS ELECTRICAL CONTRACTORS TO HOLD BIG MEETING.

Goodwin Plan and Many Vital Questions to Be Discussed at Two-Day Convention.

The Illinois State Association of Electrical Contractors and Dealers will hold a convention Feb. 14 and 15 at the Hotel Sherman, Chicago. This convention has been very well planned, every branch of the industry having equal prominence and responsibility, and it is expected that a much more stable and representative institution will develop and be given a proper start on its way to definite results. There are numerous problems which must be solved by the Illinois contractors before they can hope to realize the full benefits of the anticipated prosperity during the next few years, and this condition gives the meeting added importance. A tentative program has been drawn up which promises to bring out many interesting discussions on topics of interest. In addition, a very enjoyable entertainment program has been arranged for the members and their guests.

The convention will open Friday morning with addresses by R. W. Poelma, of Chicago, chairman of District 1, and J. A. Weishar, of Rock Island, Ill., chairman of the State Association. These will be followed by three 10-minute papers on the future of the industry by representatives of the manufacturing, jobbing and contracting interests.

Friday afternoon has been reserved for a full discussion of the "Goodwin plan" which will be led by W. L. Goodwin, originator of the plan. In the evening a theater party has been arranged for the lady guests and a stag for the members.

Saturday morning the reports of the executive and other committees will be presented, followed by a brief outline of the proposed activities for the next six months and the election of officers for the coming year. In the afternoon there will be several brief addresses by prominent men in the electrical field on the methods of getting business and how to handle it. In the evening a banquet has been arranged, to be followed by dancing, for the members and their lady guests.

Those desiring to attend are requested to notify R. W. Poelma, 55 West Harrison street, Chicago, as early as possible in order that the proper reservations may be made.

AMONG THE CONTRACTORS.

Meacham & Babcock, Seattle, Wash., have the contract to do the wiring for power and lighting of the 5-story concrete factory building being erected for the Pacific Net & Twine Co. of that city. This firm will also install five direct-current motors in the plant for operating two passenger and one freight elevators, and for driving other machines.

The Jandous Electric Equipment Co., 109 West Thirty-first street, New York City, has been awarded the contract for electric wiring, etc., in connection with the erection of the proposed new three-story and basement high school building at Waterbury, Conn., at a cost of about $45,000.

QUESTIONS AND ANSWERS

All readers are invited to submit questions and answers to this department. Anonymous communications will not be considered. Questions should relate to electrical matters of any kind. Answers contributed by readers should be submitted preferably within eight days of the date of publication of the question and should be limited, if possible, to 300 words. Payment will be made for all answers published.

Questions.

No. 453.—Series Street-Lighting Systems.—Recently I heard of a scheme for running series street-lighting circuits without a constant-current regulator, but using a transformer of special type at each lamp post. What advantage, if any, does this latter system possess? Has it been tried out and, if so, with what results?—M. D. E., Denver, Colo.

No. 454.—Grounding Three-Phase, Four-Wire Distribution Systems.—In a city employing three-phase, four-wire distribution what is the best policy as regards the grounding of transformer neutrals for single-phase transformers and for transformer banks connected for power? We have encountered difficulties from grounding the middle point of a three-phase bank and the single-phase transformers of a different phase, the grounds being on the low-voltage side.—P. T. W., Minneapolis, Minn.

No. 455.—Rates for Electric Service During Construction.—There are a large number of electrically driven construction devices which are only used temporarily during the course of construction or remodeling of buildings. Such apparatus includes hoists, floor polishers, small portable pumps, concrete mixers, etc. As they are only used for a short time, and usually by different contractors, considerable trouble has been experienced in establishing a definite equitable rate of charging for the service which they use. The installation of meters in such cases has been found unsatisfactory, as they are very liable to injury, and the total consumption of the apparatus is often less than the cost of installing the meter. Will some readers explain the methods by which a flat rate charge may be drawn up and also the methods followed in charging for service connections where such are necessary?—H. J. W., Kokomo, Ind.

Answers.

No. 450.—Meaning of "New Installations."—A discussion has arisen as to the meaning of the words "new installation" in the ordinance defining the authority of the inspector of wires of the city of Fall River, Mass. Section 2 (b) of this ordinance says:

"New installations shall not be connected with the source of the electrical supply until the inspector of wires passes its system of wiring as safe."

Does this refer to any wiring which may be done when a meter is already installed (such as installing one light in addition to 10 lights which were installed at some previous time) or an installation which has no meter in place and where it will be necessary to install a meter to deliver current to the system of wiring? What is the ruling on this in other cities?—M. T. A., Fall River, Mass.

Answer A.—A very broad interpretation of such an ordinance could be made to cover any alteration, addition or extension of an existing installation, although such an interpretation would obviously be extremely difficult to enforce unless the authorities of the city in question are meeting with much more thorough co-operation than usual from electrical contractors, from electricians of industrial plant, institutions, private buildings, etc., from the central station and from miscellaneous wiremen and the citizens in general. It is, of course, recognized in many cities that there is as much, if not more, hazard from additional wiring put in after a building is completed, inspected and electrically served. Much of this additional wiring is installed by wiremen or amateurs who have little knowledge of electrical requirements, and there have come to notice numerous cases where additional outlets have been installed by men who knew they were overloading the circuits or at least breaking the code rules, but hoped "to get away with it" through the absence of reinspection. If the inspector has specific authority to reinspect premises at any time he deems it advisable, and if he has definite authority to bring about the prosecution of anyone breaking the municipal code by installing circuits or outlets contrary to the requirements of this code, the question of preventing the practices mentioned is relatively easy. In my opinion the particular ordinance is not specific enough to do this, unless the courts before whom such prosecutions are brought are very broad-minded and recognize the need for backing up the inspector fully in his effort to protect the public from fire and accident hazards.

A strict interpretation of this ordinance would probably limit the inspector's authority to inspection of entirely new electrical installations as yet unconnected to the electrical supply source, or possibly also to such additional wiring as would require the installation of a larger service meter or service transformer and connections, wherein the co-operation of the central station could be obtained. This case shows very clearly the desirability of drafting city ordinances with very great care and so broadly as to give the inspector ample authority to inspect not only the initial installation, and to reinspect the same, but also to inspect any alterations, additions or extensions to it. With a broadly drawn ordinance and an adequate inspection force it is then possible to safeguard the community adequately.—B. J. D., Chicago, Ill.

Answer B.—On such "Applications for Permit to Perform Work," which have come to the writer's notice, the various types of work are grouped under different heads. These headings may be classified as follows: "New work," "additional wiring," "rewiring" and "alterations." Under "new work," all such wiring installations as are installed in buildings where no current has been supplied must be duly inspected and approved by the inspector before electric service may be had. The example which is given in this particular question would come under the head of "additional wiring" and could be connected to the current source before its approval by the inspector. In the event of additional wiring being so great as to require the installation of a larger meter this possibly would not hold good. Under the other headings such work could readily be connected to the already existing current supply without waiting for such approval; any required changes would have to be made upon the suggestion or demand of the inspection department, however.—W. F. P., Atlantic, Mass.

No. 451.—Grounding of Direct-Current Circuits.—Why is the number of circuit grounds on direct-current systems restricted in the new rules 15A*b* and 15A*c* of the National Electrical Code? The former requires a ground on the neutral of three-wire systems at one or more supply stations, but not at individual services or within buildings served; the second rule provides for a ground on two-wire systems at one station only. It seems to me that the more grounds there are the more perfect is the protection that is afforded.—H. J. N., Milwaukee, Wis.

Answer A.—While it is apparent that National Electrical Code Rule 15A*b* limiting the ground connection for three-wire direct-current circuits to supply stations, and Rule 15A*c* to one station only for two-wire circuits, do not provide the assurance that a number of multiple ground connections would, and which are allowed for secondaries, there are several circumstances that offset this, as follows: Direct-

current circuits are usually underground or limited to private premises and are not therefore likely to come into contact with high-voltage distributing networks; the relatively larger capacity of direct-current distributing systems makes the chance of loss of ground connection remote, and because of chance of damage, due to electrolytic action were a number of multiple ground connections allowed, it has been decided to restrict grounding as above. For discussion of this matter refer to pages 27 and 28, Circular 54, "National Electrical Safety Code," issued by the Bureau of Standards.—H. G. H., Passaic, N. J.

Answer B.—The last statement in H. J. N.'s query applies quite generally to alternating-current circuits in which numerous grounds are not objectionable. With direct current, however, indiscriminate grounding may lead to trouble unless exceptional care is taken to insure low resistance and permanency in the ground connection. For instance, suppose a building served with direct current has its circuits grounded to the water piping and the latter is in contact with the gas piping; the water piping is temporarily disconnected for repairs, so that the gas pipe becomes an imperfect ground. Current on such a ground is likely to cause serious electrolytic corrosion at pipe joints. It is also an undependable ground that may be considerably above ground potential. Station grounds can be made very substantial and permanent; their use minimizes the destructive action of electrolysis of underground piping, which is not present with alternating current. The National Electrical Safety Code contains probably the best explanation of the reasons for grounding and the best methods for effecting it. A copy can be obtained from the Superintendent of Documents, Washington, D. C., for 20 cents; ask for Circular No. 54 of the Bureau of Standards.

No. 452.—Requirement of Enclosed Knife Switches.—In how many cities and in what large cities is there a municipal or other regulation requiring the use of enclosed knife switches for motor or other heavy circuits or prohibiting use of open knife switches for such purposes?—T. B. A., New York, N. Y.

Answer A.—The ruling in many cities regarding this is similar to the general requirements of the National Electrical Safety Code, which are that switches with exposed live parts will be approved where accessible to expert supervision only, as for example, in a central station, engine room, isolated motor room, etc. There has been a marked tendency recently to use protected or guarded switches for all classes of work even in locations as above noted. Lines of protected switches which have been developed and placed on the market are now gradually replacing the former. The recommendations of the National Electrical Safety Code are for current-carrying parts of all switches in excess of 150 volts to be protected by inclosing guards, if accessible to other than qualified persons; they may be made inaccessible to other than qualified persons by being placed in locked rooms or cabinets; where not so guarded, insulated floors, mats or platforms are to be provided, also walls within 3 ft. are to be insulated. The exception to this is for switches under 150 volts, 60 amperes. Guarded switches are to be preferred and have been adopted in the best practice.—M. K., Passaic, N. J.

Answer B.—The most complete data ever compiled on this subject can be obtained from a paper by A. MacLachlan, who is connected with a switch manufacturer at Detroit, Mich., which paper was read before the last convention of the International Association of Municipal Electricians. He gave a list of municipalities that have prohibited the open knife switch on account of its life and accident hazard. I believe the city of Detroit is at the head of the list. Mr. MacLachlan, who has taken a very active part in the campaign for inclosed switches, no doubt has more up-to-date data on this list of cities available for those interested.—E. S. C., Columbus, Ohio.

NORTHERN ILLINOIS CENTRAL STATION MAKES SATISFACTORY GAINS.

Public Service Co. Increases Power Production, Appliance Sales and Number of Customers During Year.

The Public Service Co. of Northern Illinois made substantial gains in all classes of its business during the past year. The amount of electrical energy produced by the company, including the estimated production for December, was 190,310,986 kw-hr., as compared with 164,943,330 kw-hr. for 1917. The maximum demand for the year occurred at 5:30 p. m., Dec. 16, when the simultaneous reading for the various stations was 77,683 kw. The maximum demand for the previous year was 61,010 kw. and was made at the same hour on Oct. 29.

There was also a satisfactory increase in the number of customers served. In 1916 the total number of these was 75,900, in 1917, 85,421, and in 1918, 88,000.

While the increased demand was general throughout the entire territory, a considerable portion of it is identified with the growth of the immense and varied industrial manufacturing interest included in the company's territory, especially in the western and southern districts. There are many plants new and old in this territory which are connected to the company's service, making use of both electricity and gas in quantities and for purposes which a few years ago would have been regarded sensational. Recent records of its capacity for absorbing these two forms of energy have caused it to be recognized that this territory is, in this respect, the most prolific in the Middle West.

During the year several additions, extensions and changes have been made, the most notable being the installation of an additional 12,500-kw. generator at the Blue Island plant and a second 10,000-kw. generator in Station No. 9, as the new Joliet station is designated. These and other large facilities of the company enable emergencies to be met promptly. A demonstration of this was furnished by the fire in Station No. 8, at Joliet, Nov. 20. Within an hour after the circuits affected by the fire were cut out, restoration of service began and it was fully completed in 15 hours.

The sales of electrical appliances by the company during the year were also considerably in excess of those reached in the preceding 12-month period. War and the economies it compelled in households directed the attention of buyers in a large degree to the labor-saving devices and in consequence irons, washing machines and vacuum cleaners moved out in increased volume. The efficiency of these devices and the popularity they speedily attain with their users constitute factors in the operation of increasing their sales, for buyers become their verbal advertisers.

While electric irons and cooking devices, including percolators, were in the largest favor, the demand for electric fans was very satisfactory and there is no doubt that all appliances, especially the labor-saving kinds, were used more in the aggregate. One strong reason was the installation of "convenience outlets."

New Appliances

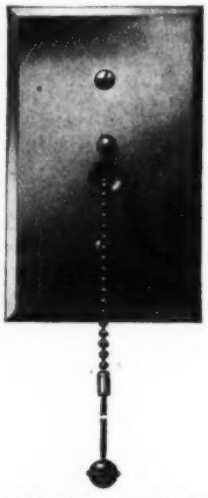
Hospital Call Switch—Adjustable Ceiling Fan—Enclosed Switches—Improved Washer—Simple Circuit Test Device

New Hospital Call Switch.

Very elaborate hospital call systems have been devised and installed, and in many instances are giving fairly satisfactory service, but one trouble often arises from their use because a great majority of them employ some form of standard wiring device which the patient uses to signal the nurse. The trouble experienced is due to the fact that the so-called standard wiring devices are not intended for such service. When used for this purpose they often break or fall apart and the result is that the patient may unfortunately come in contact with the flexible conductor carrying the voltage of the lighting circuit. Further, the flexible conductors carrying the push-button or pendent switch become soiled, worn or damp, thus making the signal inoperative.

A new device, called a "hospital call switch," has just been developed by the engineers of the Cutler-Hammer Manufacturing Co., Milwaukee, Wis. It is made for installation in a standard switch outlet box and the wiring does not extend beyond the box. No flexible conductors or push-button switches are required for its use, consequently, the annoyance of having these parts broken and soiled is eliminated. Further, as the live parts terminate in the wall, there is no possibility of the patient coming in contact with them. Therefore, it has none of the objectionable features spoken of above and besides offers a means of making a much neater and cheaper installation.

From the accompanying illustrations it will be seen that the new device consists of a C-H standard push and pull mechanism slightly modified. The switch is operated by a pull on a push-button. A push-button located above the horn extends through the plate and is used by the nurse to push the switch off. The plate is the same size as those used for wall switches and receptacles and the switches and the plates are made singly or in gangs. The new device may be used on any standard lighting circuit of 125 volts or less.



Hospital Call Switch Operated by Patient's Pull on the Linen Cord and Released by the Nurse's Push on the Button Above.

Rear View of Hospital Call Switch, Showing Small Proportions and Wiring Connections.

chain. A linen cord placed within easy reach of the patient is used to pull the switch "on," the cord being attached to a short piece of chain which extends through a horn in the plate and is attached to a projection

Hunter Ceiling Fan with Adjustable Blades.

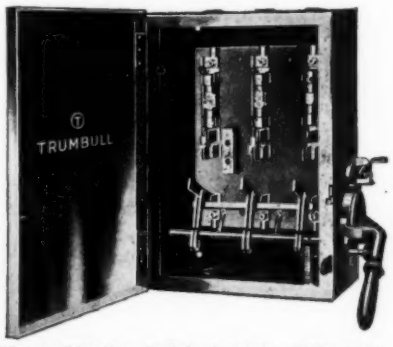
The ordinary ceiling fan has its blades arranged to blow downward. This proves troublesome in many cases due to too concentrated a draft directly below the fan which may prove chilly to a person, disturb papers on a desk or table, or stir up the dust on the floor. Experiments conducted by the Hunter Fan & Motor Co., 36 West 37th street, New York City, have shown that very much better results are obtained from a ceiling fan that blows upward. In the first place, the disadvantages mentioned are entirely overcome and a pleasant and very effective air current is caused to move upward from a wide zone under the fan; in the second place, this air current moves in a natural direction and is really an intensified movement of a greater volume of air that normally moves toward the ceiling, consequently the air movement is more efficient; and in the third place the upward moving air is cool air from the lower parts of the room, whereas the downward draft of the ordinary ceiling fan forces heated air from the ceiling down to the breathing and working zone.

The company has therefore brought out what is known as the type C-18 adjustable-blade ceiling fan, which is an improvement on a similar model developed a year ago. The blades of this fan can be adjusted to blow the air up or down; it is also possible to secure intermediate adjustment of the blades to make the air current strong or moderate. These adjustments can be made while the fan is in motion. The fan is equipped with either 2 or 4 blades, as preferred; where 2 blades are used they have a sweep of 56 in.; while the 4-blade set has a sweep of 52 in. In either case the blades have mahogany finish. A low-speed induction motor is furnished and gives very efficient results.

Hunter Alternating-Current Ceiling Fan With Blades Adjusted to Blow Up or Down.

New Trumbull Safety Service Switches.

To an already extensive line of enclosed safety switches the Trumbull Electrical Manufacturing Co., Plainville, Conn., has recently added some new types and sizes, as follows: Fuseless switches, single and double throw, 250, 500 and 600 volts; fusible switches, double throw; 400 and 600-ampere switches of one, two, three



Motor-Starting Safety Switch of Straight-Through Type with No-voltage Release Coil.

and four-pole types; "straight through" motor-starting switches with under-voltage release coil; motor-reversing switches.

These new switches, the company states, like those already included in its line of "Circle T" safety switches, are not merely enclosed switches externally operated but designed primarily for their ruggedness and safety features. The box cannot be opened until the switch is in "off" position. A catch prevents the switch from being closed while the box is open; however, if necessary to close the switch during inspection, it may be manipulated while the box is open, but this can be done only by an experienced man. To the ordinary user the blades and fuses are always dead whenever the switch is exposed, thus eliminating fire and shock hazards from exposed live parts. In the construction of these safety switches the company uses its type A knife switches, which for many years have been recognized as of highest standard knife-switch construction.

In designing these switches the thought was not merely to put a box about a switch and arrange the latter to be operated outside of the box, but first build a very sturdy knife switch that can withstand the extra hard usage it will be subjected to when enclosed in a box that prevents seeing how the switch is operating, and then arrange for the enclosing and external operating mechanism so that the latter will function properly in all cases. It is felt that the purchaser is not primarily buying a box containing a switch, but rather a switch built to render the hardest service in the hands of an unskilled and not electrically informed operator, who must be protected from all hazards. The company's aim has been to make safety switches that will be looked upon, like its type A knife switches, as a standard guarantee of electrical and mechanical strength in switch construction. Possessing unusual endurance and the safety enclosure and operation, the company states that the slight additional first cost is neglible in making the switch installation safe for person and property.

Electric Washer with Cone Device in Tub.

Of the many types of washing machines it is generaly agreed that the so-called dolly type is the least expensive and therefore most generally employed. It has the disadvantage, which is also possessed by some other types, however, of tending to bunch the clothes in a tight wad in the center of the tub. If the clothes are bunched or twisted into a tight mass the hot soapy water cannot readily enter the interior of the mass and therefore the cleansing action, which consists in swirling the water through the fabric, is materially retarded. To overcome this shortcoming of the dolly type washer, the Hirschy Co., 720 Second avenue, South, Minneapolis, Minn., has developed a new cone device, on which patent has been applied for, that is inserted in the center of the tub as shown in the accompanying cut in which the tub is partly broken away to expose this feature to view. It is said that this cone forces the clothes to follow a wider circle and therefore to move through a larger volume of water. The slant of the cone is also claimed to give the water a greater agitation and thus to keep the clothes free from each other so that the hot suds can more effectively penetrate every portion of the fabric and loosen the dirt. The cone has a top lip that prevents the clothes from rubbing against the dolly and so eliminates wear and tear. This improvement is claimed to make the washer so much more efficient that even the most soiled clothes may be washed in 10 to 12 minutes, while ordinary clothes may be cleansed in half this time; marked time economy is thereby effected in the week's washing.

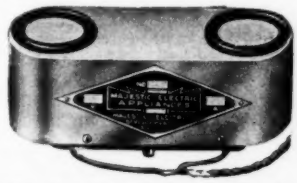
Hirschy Electric Washer With Cone Device in Tub to Keep the Clothes Moving in a Large Circle

This washer also has other important features. With the exception of the tub, which is of high-grade southern cypress, the entire machine is made of metal; this includes a double folding platform which is very serviceable where there are no stationary tubs. Large double casters make the machine easy to move. All the machinery is enclosed and the operator's clothes protected from being caught in gears or belts. A three-position, tilting and swinging ball-bearing wringer is provided. It is easily controlled and arranged with a positive safety release that unlocks the top roll by merely giving it a slight lift.

Determinator for Quickly Testing Circuits.

When motors, transformers or any instruments operated by electricity are to be installed, the first thing necessary is to find out what class of current the building is supplied with. Formerly there were only two common ways for finding this out: First, by "feeling the juice," which should never be done as it is always extremely dangerous. Second, by asking the central station, which puts the latter to considerable trouble and places an unnecessary responsibility upon its shoulders which it is usually not willing to assume. This method is also uncertain as both kinds of service may be supplied.

The Majestic Determinator is an instrument as simple in operation as it is certain. To operate it, all that is necessary is to place the end plugs to the wires or terminals, press the button at the bottom of the Determinator, and if the current is direct, the letters "D. C." will instantly appear within one of the circles at the top of the Determinator; if the current is alternating, the letters "A. C." will appear within the other circle. The brilliancy of the light back of the letters A. C. or D. C. tells whether the voltage is 110 or 220. The plugs attached to the Determinator are knife-blade type and are so constructed as to render short-circuits or shocks impossible.



Majestic Determinator for Showing Instantly Whether Tested Circuits Are Direct or Alternating Current.

With this device all open fuses and circuit breaks may be accurately determined. Broken wires or coils, as well as bell and lighting circuits may be accurately tested with this instrument, which should prove of value to contractors, electricians, wiremen, etc.

The device has no delicate or moving parts or fuses, therefore it is not liable to get out of order. It is 4 in. long, 2 in. high and 1½ in. wide, and it weighs only 7 ounces.

The Majestic Determinator is being manufactured and marketed by the Majestic Electric Development Co., 656 Howard street, San Francisco, Cal.

Trade Activities

Oven Installations of Young Brothers Co.—North Coast Electric Opens Portland Branch—Special Literature

Westinghouse Electric & Manufacturing Co., at its Portland branch, has sold a 150-hp. motor for installation in a flour mill at Pasco, Wash., where additional equipment required more power.

Square D Co., Detroit, Mich., manufacturer of Square D switches, opened a new Metropolitan office at 149 Broadway, New York City, on Jan. 1. J. A. Jaques, district sales manager, has been placed in charge of the office. Mr. Jaques was formerly connected with the Pittsburgh office of the Square D Co. At one time he was a member of the sales organization of the Western Electric Co. Mr. Jaques will represent Square D interests throughout the Metropolitan district.

Century Electric Co., St. Louis, Mo., is meeting with success in the sale of its automatic-starting polyphase motors through its Seattle and Portland branches. A number of motors of this type have been put in service by the Seattle North Pacific Shipbuilding Co. in the plant of Washington Excelsior Co., the municipal shops of Tacoma, one of the lumber mills at Astoria, and are used to operate dock equipment at Portland. The automatic-starting feature, requiring no compensator, appeals strongly to operators.

The Webster & Perks Tool Co., Springfield, Ohio, has prepared a handsomely illustrated bulletin which has for its subject W & P pointing, thread-cutting and special tapping machinery. This book discusses briefly the development of horizontal thread-cutting and special tapping machinery and directs particular attention to the simplicity of operation and adjustment of these machines and their accuracy of production. Complete and comprehensive descriptions of the machinery are given in addition to other helpful information.

North Coast Electric Co., electrical jobber, Seattle and Tacoma, Wash., has opened a branch at 331 Everett street, Portland, Ore., where a large stock of electrical supplies will be carried. L. S. Ruble, formerly with the Northwestern Electric Co., and later with the Coast Steel & Machinery Co., has taken charge as salesman and storekeeper. During the country's war period, Mr. Ruble was in the Engineers' Supply Depot of the War Department, stationed at Vancouver, Wash., and Ft. Douglas, Utah. In those positions he developed and put in effect some original plans for the storekeeper for electrical and engineering supplies. The Electrical Purchasing Agents' and Storekeepers' Association, organized by Mr. Ruble before the war, is to be revived.

Shepard Electric Crane & Hoist Co. has opened an office in the new Lexington building, Baltimore, Md. Norman P. Farrar, who has been district manager of the Philadelphia territory for a number of years, will be in charge of the office.

National X-Ray Reflector Co., Chicago, is distributing a new book entitled, "X-Ray Indirect Lighting for Offices." It covers the office lighting field very comprehensively, showing the advantages of cove, compone fixture and luminous bowl lighting, and the imperative necessity for better lighting in offices. This book contains a number of illustrations that speak for themselves. These photographs are unretouched and are all taken by the X-ray indirect lighting only.

S. Flory Manufacturing Co., with main office and works at Bangor, Pa., manufacturer of high-grade hoisting machinery—steam, electric and gasoline—for contractors, mines, quarries, etc., is distributing its 1919 catalog No. 26, describing and illustrating its products. Its line of marine auxiliaries includes winches, capstans, dock hoists, spud hoists, pile drivers, dredging machinery, marine railway hoists, etc., etc. The company has a very modern plant, with excellent facilities for manufacturing various types of machinery illustrated in the catalog and specifications covering particular requirements will be furnished on request. The suspension cableway system of hoisting and conveying is one of the company's specialties. Copies of the book will be furnished on application at any Flory office.

Young Brothers' Insulated Steel Ovens in Demand.—Bradford-Ackerman Corporation, 30 East 42nd street, New York City, eastern representative of Young Brothers Co., manufacturer of insulated steel ovens, reports a large amount of interest in electrically-heated ovens for japanning, enameling, drying and core and mold baking. It reports business in this line during 1918, closed and in operation, as follows: Curtiss Aeroplane Corporation, Buffalo, N. Y., kiln oven for japanning aeroplane parts; General Electric Co., Schenectady, N. Y., seven ovens, kiln type, for general electric machinery drying and baking; Federal Shipbuilding Co., Newark, N. J., kiln ovens for drying armatures and coils; Fillmore Avenue Foundry & Iron Works, Buffalo, N. Y., kiln oven for japanning; Ericsson Manufacturing Co., Buffalo, N. Y., drawer pull oven for japanning magnetos; Fairbanks Co., Philadelphia, Pa., two ovens (one for France) for japanning aeroplane parts; Taylor-Wharton Iron & Steel Co., High Bridge, N. J., drawer pull oven for foundry core baking; S. O. & C. Co., of Ansonia, Conn., kiln oven, recirculating system for japanning eyelets, etc.; Sprague Electric Works, Buffalo, N. Y., kiln oven for drying armatures and coils; Connecticut Electric Steel Co., Hartford, Conn., drawer pull oven for foundry core baking; Crouse-Hinds Co., Syracuse, N. Y., kiln oven for foundry core baking, and Pratt & Whitney, Hartford, Conn., drawer pull oven for core baking.

In addition, the Electro Dynamic Co., of Bayonne, N. J., purchased three large kinln ovens, steam heated, for drying its armatures used in the Interpole motors and generators. The company also purchased a special continuous conveyor oven, gas heated, which is used in the drying of varnish insulations on the armature and field pole laminations. These laminations were formerly air dried, requiring some forty-eight hours, and the whole operation now is done, and more effectively, in the short interval of three minutes.

Pacific States Electric Co. has been appointed exclusive Pacific coast sales agent for the wire products of the Anaconda Copper Mining Co., rolling mills department, of Great Falls, Mont. This line of products consists of bare copper wire of all kinds, including solid and stranded wire cables, as well as trolley wire and feeders. This new representation gives the company a high-tension transmission department which is able to supply complete equipment for transmission-line construction, including poles, hardware and guying material, insulators and copper conductors, etc.

J. Livingston & Co., Inc., New York City, constructing engineer, designer and manufacturer of electric light and power systems, is sending out Section 1 of its Catalog No. 100 which has for its subject "Industrial Lighting Fixtures." This bulletin of 26 pages emphasizes the importance of correct illumination in the industrial plant and presents various designs of lighting fixtures and reflectors designed especially to correctly illuminate factories, mills and all types of industrial buildings. The section shows fine drawings of flat cone reflectors, shallow bowl reflectors, deep bowl intensive reflectors, deep bowl extensive reflectors, angle type and elliptical angle reflectors, accompanied by charts showing the photometric light curves of each type. Other sections of the catalog covering various lines of electrical apparatus and merchandise are in preparation. The Livingston company offers a complete electric service, covering the entire field of industrial electrical apparatus, a service which is backed by 20 years' experience in the planning and installation of industrial electrical apparatus.

Current News

Weekly Record of Construction Activities—Conventions

EASTERN STATES.

West Dudley, Mass.—Contracts for the installation of machinery in the new hydroelectric power house in course of erection have been awarded by the Burmas Paper Co., Inc. The power house, which will be 45x54 ft. in size, of brick construction, one-story high, and a concrete dam, 150 ft. long and 10 ft. high, are being erected under the direction of Thomas F. McGovern. The cost of these improvements is approximately $50,000.

Leicester, Mass. — Arrangements have been completed with the Worcester Electric Light Co. for furnishing electric service for the operation of the street-lighting systems on Mulberry and Marshall streets, at the rate of $36.00 per unit.

Worcester, Mass.—The Ordnance Department has awarded a contract to the Thomson Electric Welding Co., 3 May street, for supplying welding adapters and booster casings, at a total cost of $58,500.

Worcester, Mass.—Quarrey Floral Co., 148-50 Main street, is having plans prepared for the construction of a one-story brick boiler plant, about 20x75 ft., to be erected in connection with another structure at 877 Main street. The Samuel H. Pitcher Co., 44 Front street, is architect and engineer.

Providence, R. I.—Revere Rubber Co., Valley street, is having plans prepared for the construction of a one-story brick power plant, about 50x90 ft., at Valley and Hemlock streets.

Bath, N. Y.—An appropriation of $24,000 for installing electric system, including alternating current generator, engine, switchboard, voltage regulator, etc., and $89,200 for heating system, consisting of four boilers, underground heating line, hot water plant, etc., has been asked by the board of directors of the New York State Soldiers and Sailors Home, Albany.

Brooklyn, N. Y.—The Government, Navy Department, has awarded a contract to the Franco American Construction Co., 150 Nassau street, New York, for the erection of an extension to power plant "A" at the local navy yards.

Brooklyn, N. Y.—Considerable new electrical and mechanical equipment will be required in connection with the construction of a large new grain elevator at the barge canal terminal at Gowanus Bay, South Brooklyn, for which a bill calling for an appropriation of $1,000,000 to provide for erection has been introduced in the Legislature by Senator Gibbs.

Brooklyn, N. Y.—The Government, Navy Department, has broken ground for the construction of the proposed light machinery and electrical shop at the local navy yards. The Lustbader Construction Co., 103 Park avenue, New York, is the contractor.

Brooklyn, N. Y.—In connection with the new Army Supply Base, located south of and adjoining the Bush Terminal property along the South Brooklyn water front, occupying a total area of about 57 acres of land and comprising four large buildings, it is interesting to note that electrical energy for all phases of operation is supplied by the Brooklyn Edison Co. The installation comprises new 6,000-volt, 60-cycle, 3-phase underground lines direct connected to the power house of the Edison company at 69th street. The central boiler plant at the supply base, which furnishes heat for all buildings, includes six water-tube boilers, each of 440 hp. capacity, normal rating, water being supplied to the boilers by three centrifugal pumps, two driven by direct-connected steam turbines, and the other by a direct-connected electric motor.

Cohoes, N. Y.—The city has awarded a contract to the Alpha Electric Co., 124 Hudson avenue, Albany, for the installation of a new pumping unit in the municipal station on North Mohawk street. The proposed work will cost $5652. Edward Haynes is city engineer.

Fort Lafayette, N. Y.—The Bureau of Yards and Docks, Navy Department, has awarded a contract to the United Electric Construction Co., 101 Park avenue, New York, for electrical work at the local Government site, at $4250.

Jamestown, N. Y.—The local Chamber of Commerce, E. D. Bevitt, secretary, are furthering plans for the construction of a new central power plant for municipal service.

Delaware, N. Y.—Sullivan Electric Co., Callicoon, Sullivan county, has filed application with the Public Service Commission for permission to construct and operate a new local light, heat and power plant.

Johnstown, N. Y.—Adams & Co. will erect a fireproof factory building, estimated to cost $60,000. Electric power will be used throughout the building.

New York, N. Y.—United Electric Light & Power Co., 130 East 15th street, has awarded contract for the construction of the proposed new motor generator building, about 26x74 ft., to be located at the Harlem River Station at Academy and 201st streets, to cost about $16,000. The Louis Weber Building Co., 171 Madison avenue, is the contractor.

Rensselaer, N. Y.—The common council received from President Henry Meurs the recommendation that a committee be appointed to confer wtih the Albany Southern Co. to ascertain the cost of the establishing of a "white way" on Broadway from Columbia to John streets.

Rockaway, N. Y.—Bureau of Yards and Docks, Navy Department, has completed plans for the installation of a new underground cable system at its local site.

Wellsville, N. Y.—Plans are under consideration by the Pure Carbon Co. for the construction of a boiler plant at its works to provide increased operations.

Annandale, N. J.—Plans are under consideration by the Borough officials for the installation of a new electric street-lighting system. It is understood that electric energy will be supplied by the Hunterdon Electric Light & Power Co. of High Bridge.

Jersey City, N. J.—In arranging its annual appropriations, the Board of Education has requisitioned the sums of $95,000 to provide for electric power and fuel, and $15,000 for gas and electric lighting purposes for 1919.

Newark, N. J.—Public Service Railway Co. has been granted a reduction of $743,662 in the valuation for assessment purposes placed by the Newark Tax Board on its rolling stock. The reduction in assessments placed on the property of the Public Service Electric Co. throughout Essex county aggregating $5,138,729.37 was denied by the Essex County Board of Taxation.

Newark, N. J.—The Board of Education will receive bids about April 1 for a four-story school building, 200x 200 ft., of reinforced concrete and brick construction. Plans include laboratories and power plant, etc. Cost about $500,000.

Passaic, N. J.—New York Belting & Packing Co., Passaic street, is rushing to completion the erection of the new power plant at its local works, and it is understood that operations will be inaugurated at an early date.

Altoona, Pa.—Penn Central Light & Power Co. has filed notice with the Public Service Commission of a bond issue of $70,000, to be used, in part, it is understood, for improvements, extensions, etc.

Orangeburg, S. C.—The city has plans for the installation of additional generating unit in electric light plant. Address the mayor.

Sumter, S. C.—The city has voted a bond issue for $350,000 to provide for the installation of an electric light and power plant.

Albany, Ga.—Albany Power Manufacturing Co. has been sold to Foy & Shemwell & Foy Co., who will operate the plant here under the name of the Georgia-Alabama Power Co. It is the purpose of the corporation

to use all its plants together, making an available horsepower supply of 50,900 for the three plants, with its steam auxiliary plants.

Atlanta, Ga.—March 5 an election will be held to decide the question of issuing $300,000 in bonds for constructing a plant for generating electricity and a distribution system in connection therewith at the crematory.

Lyerly, Ga.—J. S. Owings, Lyerly, and N. K. Bitting, Summerville, are considering plans for the installation of an electric light plant at their local works.

Savannah, Ga.—Foundation Co. will establish an electric power plant at its shipbuilding plant.

Bunnell, Fla.—The city has approved a bond issue for $15,000 to provide for the installation of a new electric light plant and improvements in the water system.

Leesburg, Fla.—Movement for issuance of bonds for following municipal improvements has been begun: City hall, paving of five streets and purchase of electric light and waterworks plants. Address mayor.

Miami, Fla.—Miami Ocean View Co. is considering plans for the installation of a new electric lighting system.

NORTH CENTRAL STATES.

Columbus, Ohio.—The State Public Utilities Commission has authorized the sale of the Rocky River Light & Power Co. to the village of Rocky River, near Cleveland, for $63,000.

Hamilton, Ohio.—The Hamilton municipal lighting plant is unsatisfactory. Address F. J. J. Sloat, director of Public Service.

Milton, Ohio.—Realizing the opportunity of developing more power from the waters of the Walla Walla river, the M. B. Electrical Co. has filed a right to take water from a location near the Rod bridge in Milton and expects to install an electrical plant costing about $25,000. A survey has been made and found that about 350 hp. can be developed from this source. Work will be started immediately and it is expected that the power will be ready for use within the near future, and not later than this year at the most.

Norwalk, Ohio.—The City Council has reduced the municipal net wholesale power rate to one and one-half cents a kilowatt. To secure this rate patrons must use more than 17,000 kw. per month. Council cut the price to meet competition of a private corporation and to offer a special power inducement to manufacturers.

Wellington, Ohio.—The power plant is to be enlarged from 300 hp. to 500 hp. by the addition of either gas producers and gas engines or new boilers and a steam turbine. C. E. Gadfield, superintendent, is in charge of the work.

Elkhart, Ind.—The Toledo & Eastern Railway Co., purchasers of the old "Valley Line" right-of-way between Lagrange and Mongo, has filed a petition with the State Public Service Commission asking authority to sell $90,000 worth of stock at par and to issue bonds amounting to $35,000. Money for the sale of these bonds will be used to pay the purchase of indebtedness of the road and to provide a fund to make improvements and maintain the property. Address D. F. Milne, superintendent, Frankfort.

DATES AHEAD.

Illinois State Association of Electrical Contractors and Dealers. Annual convention, Chicago, Feb. 14 and 15. State secretary, G. A. Engelken, 55 West Harrison street, Chicago.

New Mexico Electrical Association. Annual meeting, Albuquerque, N. Mex., Feb. 17-19. Secretary-treasurer, Charles E. Twogood, Albuquerque, N. Mex.

American Institute of Electrical Engineers. Annual mid-winter convention, Engineers Societies building, New York City, Feb. 19-21. Secretary, F. L. Hutchinson, 33 West 39th street, New York City.

Society of Industrial Engineers. National conference, New York City, March 18-21. Secretary, Irving A. Berndt, 327 South La Salle street, Chicago, Ill.

Wisconsin State Association of Electrical Contractors and Dealers. Annual convention, Hotel Pfister, Milwaukee, Wis., March 24-28. State secretary, John A. Piepkorn, 108 Sycamore street, Milwaukee, Wis.

Wisconsin Electrical Association. Annual meeting, Milwaukee, March 25-27. Secretary, J. P. Pulliam, 1408 First National Bank building, Milwaukee.

Tri-State Water and Light Association. Annual meeting, Greenwood, S. C., April. Secretary-treasurer, W. F. Steiglitz, Columbia, S. C.

American Society of Mechanical Engineers. Spring meeting, Hotel Statler, Detroit, Mich., June 17-20. Secretary, Calvin W. Rice, 29 West 39th street, New York City.

Ohio Electric Light Association. Annual meeting, Cedar Point, Ohio, July. Secretary, D. L. Gaskill, Greenville, Ohio.

Newcastle, Ind.—Pan-American Bridge Co. will build additions and install machinery to cost $50,000.

Champaign, Ill.—The Illinois Trust and Savings Bank will do extensive remodeling, throwing two business rooms into one, and will install new fixtures and equipment.

Chicago, Ill.—Walter J. Conlon, president of the Conlon Electric Washer Co., has secured a $135,000 loan from William C. Heinemann & Co., running six years at 6%, the proceeds to be used for the construction of a new building at 52nd avenue and 19th street. The estimated cost of the improvements is $225,000.

Mattoon, Ill.—Mattoon will in a few months have new boulevard lights from 14th street to 21st street along Broadway, and also on 16th and 17th streets, according to the decision of the city board of water and light commissioners. Address Claude James, superintendent of the city water and light plants.

Peoria, Ill.—Fire damaged the plant of the Peoria Cordage Co. estimated at $35,000.

Morenci, Mich.—At the meeting of the village council the lighting question was taken up and a plan was submitted to the Southern Michigan Light & Power Co. for an estimate to include more lights, one on each corner, the lights to be of less candlepower than those now in use.

Quincy, Ill.—The city council is in favor of purchasing or installing a plant to generate electric power. Address city clerk.

Marquette, Mich.—Marquette's electric light and power plant came up for discussion at the commission meeting, when Commissioner Sherman reported on investigations he has had under way on whether it would be wise to build the new plant now or later.

Eau Claire, Wis.—International Toy Co. is considering building a plant with a separate transformer station and office building. Address L. D. Pangborn, president, 1114 57½ avenue.

Jim Falls, Wis.—American Public Utilities Co. of Grand Rapids, Mich., has incorporated with a capital of $200,000 to build a $2,000,000 power house and dam.

Milwaukee, Wis.—In answer to a complaint by the city, the street car company informed the council that they will replace the present globes with new globes as soon as possible. Address James D. Mortimer, president of the Milwaukee Electric Railway & Light Co., 215 Sycamore street.

Littlefork, Minn.—Littlefork Light & Power Co., Inc., contemplates building an electric light and power plant. E. Polinghorne is interested.

Moose Lake, Minn.—H. L. Bailey, General Light & Power Co., Cloquet, is considering rebuilding the electric lighting system, recently burned.

Waterloo, Iowa.—The Waterloo, Cedar Falls & Northern Railway will install safety devices at the crossings. Address C. D. Cass, general manager.

Altenburg, Mo.—Work has begun on the new building which is to house the electric light plant and it is expected to be ready for business some time in March.

Excelsior Springs, Mo.—Excelsior Springs Light & Power Co. contemplates extending its electrical system to Holt, Kearney, Lawson, and other cities.

Fulton, Mo.—The Board of Managers of the State Hospital is considering the construction of a power plant at the institution, estimated to cost, with equipment, $67,000.

Guilford, Mo.—C. C. Helmers, manager of the Maryville Electric & Power Co., says that he will consider a proposition to extend its light system to Guilford on the same plan that other towns in the territory have been served, namely, a 20-year franchise and a cash bonus of about $5000.

Miller, Mo.—A franchise has been granted to J. R. Alexander to install an electric light plant. The Delco company will install all of the machinery and apparatus and turn it over to Mr. Alexander in working order.

Marshfield, Mo.—Plans have been announced for a hydroelectric plant on the Niangua river to supply light and power for the city. The Missouri Valley Water Co. is planning to construct the dam for citizens of the community.

Macon, Mo.—The city plans to improve its waterworks and electric lighting systems. The work will involve an expenditure of about $45,000.

Sikeston, Mo.—The city is considering a bond issue to provide for the construction of a new municipal electric light plant.

Downs, Kans.—United Light & Power Co. has been chartered with $50,000 capital stock by D. B. Harrison, Downs; W. A. Welch, Glen Elder; and C. M. Higley, Cawker City.

Osborne, Kans.—The city of Downs has purchased the electric light distributing lines from the Downs Electric Light & Power Co. and will buy its electric current from the Union Light & Power Co., a new corporation which has bought the plant and lines of the Solomon Valley Electric Light & Power Co. This new company will supply current for the following towns: Downs, Cawker City, Glen Elder, Portis, Cedar, Gaylord, Harlan and Kirwin.

Oswego, Kans.—A new electric and power plant will probably be installed in the near future.

Randolph, Kans.—Randolph Light Co. will sell its property at public auction Feb. 22. The property consists of an engine, a dynamo, batteries, moving picture machine, etc.

Verdigre, Neb.—Verdigre Creamery Co. is making plans for rebuilding creamery and installing large electric power plant. Work on this plant will be started this summer.

Columbia, S. Dak.—An issue of $15,000 bonds for the installation of a municipal electric light system was authorized at a special election held recently.

Madison, S. Dak.—Bids will be received Feb. 10 for $100,000 electric light bonds, yielding 5½% interest. Address William Rae, city auditor.

SOUTH CENTRAL STATES.

Manchester, Ky.—Columbia-Panama Coal Co. has commenced the construction of the proposed power plant at its local properties.

Selma, Ala.—The city is considering the establishment of an electric lighting plant. Address Louis Benish, mayor.

Union Springs, Ala.—$10,000 in bonds has been voted to improve the light and water plant. Address mayor.

Natchez, Miss.—The city contemplates building an electric light plant. Address mayor.

Benton, Ark.—S. A. Smith, superintendent of water plant, has leased electric plant and will purchase same. After the purchase, engine and generator, repairs and renewals to be made on distribution system.

New Orleans, La.—New Orleans Railway & Light Co. will spend $60,000 for new frogs and switches. J. D. O'Keefe, receiver.

New Orleans, La.—Fire recently destroyed the building of the New Orleans Railway & Light Co. on Napoleon avenue.

Cisco, Tex.—Cisco Gas & Electric Co. will enlarge its electric light and power plant.

Frederick, Okla.—Plans are being made to enlarge and improve the electric light plant. A new building may be erected. A white way on Grand avenue is also contemplated.

Tishomingo, Okla.—The construction of an electric light plant to cost $18,000 is contemplated. Address the mayor.

Dallas, Tex.—Dallas Railway Co. has been granted an extension of time to Dec. 1, 1919, by the city commission in which to begin the construction of extensions of its street railway system and the making of other improvements to cost $1,200,000.

Dallas, Tex.—It is reported that the Southern Traction Co. will take steps soon to carry out its deferred project of extending its interurban electric railway from Waco south to San Antonio, via Austin, a distance of about 185 miles. Its plan involves the construction of an electric power station at Austin.

Houston, Tex.—E. E. Sands, city engineer, will soon receive bids for improving the waterworks system. The plans include seven deep wells, pumps, motor and electric generators. The estimated cost of these improvements is about $160,000.

Mineral Wells, Tex.—W. J. Walder, of Mineral Wells, and associates are promoting the construction of an interurban electric railway between Fort Worth and this place, a distance of about 65 miles. It is possible that the proposed line may extend as far west as Cisco.

Orange, Tex.—Orange Light, Ice & Water Co. has just installed a new 750-kw. unit in its electric light plant.

WESTERN STATES.

Glendive, Mont.—The Board of Trustees at the Chamber of Commerce contemplate extending phone line out to Bloomfield territory and establishing local exchanges at Bloomfield.

Lamar, Colo.—The town of Lamar is being served by the Intermountain Railway, Light & Power Co., of which E. C. Diest of Colorado Springs is president. The town of Lamar, through W. E. Free, city attorney, has filed a complaint alleging that the company is unable to furnish power sufficient for additional street lighting, and for that reason a municipal power plant is being considered.

Florence, Ariz.—The city plans an election to vote on $80,000 bonds for water supply system and an electric light and power plant.

Humboldt, Ariz.—Humboldt Improvement Co. has had plans prepared for the construction of a new electric light plant for furnishing service at Humboldt and vicinity.

Seligman, Ariz.—E. L. Beyard and associates are said to be arranging the organization of a new concern to be known as the Mojave Northern Power Co., capitalized at $24,000,000, for proposed hydroelectric development on the Colorado river, near Seligman and Williams.

Everett, Wash. — Norway Pacific Drydock & Construction Co. has received orders from the government for five new ships. The first keel will be laid about the middle of March. These five vessels will be coast guard cutters. The price involved is $3,435,000. Contract calls for delivery between Dec. 31, 1919, and April 1, 1920.

Seattle, Wash.—The city council passed an ordinance providing $15,000 for the purchase of a site at Whatcom avenue and Spokane street on which will be erected a main step-down station to relieve from overtaxing the station of the city lighting department at Seventh avenue and Yester Way. It is the intention to erect a frame structure of sheet iron temporarily.

Reedsport, Ore.—Reedsport is to have an electric light company which will operate a plant sufficient to furnish lights to the business houses. A company has been formed for this purpose.

Arbuckle, Cal.—Tyler & Ross, Los Angeles, have completed arrangements for the construction of a pumping station to be used for the irrigation of approximately 200 acres of orchard lands at Arbuckle. It is understood that the station will be electrically operated, to have a capacity of pumping 1000 gallons per minute.

Bakersfield, Cal.—Surveys are being made by E. F. Prouse, assistant engineer, for the Southern California Edison Co., Los Angeles, for a large hydroelectric plant in Kern River Valley. Plans, which include the construction of a large dam, will involve the expenditure of about $10,000,000. W. Dennis, Los Angeles, chief engineer.

PROPOSALS

Boilers, Etc.—Bids for new boilers and heating work, including boilers and changes to central heating plant, Utica State Hospital, Utica, N. Y., will be received by the State Hospital Commission, Capitol, Albany, N. Y., until 3 p. m., Feb. 11.

Storage Battery, Switchboard, Etc.—Bids will be received at Cincinnati, Ohio, Feb. 13 for the following fire alarm equipment: One storage battery, one switchboard, one siren or wildcat whistle, and one or more fire alarm boxes. Address S. E. Wilson, city clerk.

Power Plant Equipment.—Until Feb. 17, bids will be received by the Bureau of Yards and Docks, Navy Department, Washington, D. C., for installing machinery equipment and piping in power plant (Specification 3328) at Hampton Roads, Va., to cost about $60,000.

Boilers, Generators, Etc.—Bids will be received Feb. 26 for rebuilding the municipal light plant at Julesburg, Colo. The specifications include one 25-kv-a. generator, alternating current, direct-connected to steam engine; two 250-hp. watertube boilers; auxiliary steam equipment; switchboard equipment; concrete or brick chimney; pole line material; centrifugal pump, etc. Plans can be had from Henningson Engineering Co., Omaha, Neb., on deposit of $10.00. Address G. H. Austin, mayor.

Personal

C. K. Cregier President of Inspectors' Association—E. S. Howe to Represent Westinghouse Company in Philippines

F. W. ROEBLING, JR., head of the engineering branch of John A. Roebling's Sons Co., Trenton, N. J., manufacturer of wires, cables, etc., is suffering from a nervous breakdown, and has gone to a private sanatorium near Philadelphia for a prolonged rest.

LIEUT. LOUIS O. MONROE, who previous to entering the national service was in charge of the Chicago office of the Clarage Fan Co., Kalamazoo, Mich., has returned to the organization and will act as manager of sales and chief engineer of the company.

GEORGE J. EBERLE, of the economics faculty of the University of Wisconsin and former expert for the Wisconsin Railroad Commission, has received leave of absence for three months to examine transportation problems for the street railways of Winnipeg, Can.

JOHN I. CATHERMAN, formerly assistant engineer of maintenance of way of the Illinois Traction System, but for the past several months in military service, has been appointed head of the maintenance of way department and has assumed his duties. He will maintain his headquarters at Springfield, Ill. He succeeds L. B. Martin, who was recently named general superintendent. Mr. Catherman was formerly with the Pennsylvania Lines, but has been associated with the Illinois Traction System since 1913.

LIEUT. EDWARD S. HOWE, Engineers, U. S. A., following his discharge from the army, will proceed to the Philippine Islands, where he will act as a commercial engineering representative of the Westinghouse Electric & Manufacturing Co. Lieutenant Howe was born in Kingston, Mass., and was graduated from the electrical engineering course of the Massachusetts Institute of Technology in 1910. After a period of service in the shops and Boston office of the Westinghouse company, he spent two years at Medillin, Columbia, S. A., returning to the States early last year to enter the national service.

C. K. CREGIER, of Chicago, recently elected president of the Western Association of Electrical Inspectors, is assistant-chief of the Electrical Inspection Bureau and one of the most popular electrical men in the West. He has been engaged in municipal electrical work for the past 20 years, being one of the original civil service employes of Chicago. Mr. Cregier will be remembered as the originator of the Phonoidograph, probably the best device so far developed for reproducing the human voice in connection with moving pitcures. Although the introduction of the Phonoidograph was stopped by the war, plans have been completed for the continuation of this work, the device having been materially improved by using audions perfected by the Government during the war. Mr. Cregier is the son of former Mayor Dewitt C. Cregier, of Chicago.

JOHN B. TRESCOTT, formerly district sales manager for the Wesco Supply Co., St. Louis, Mo., has joined W. N. Matthews & Brother as assistant manager of the industrial division. Mr. Trescott was connected with the Wesco company for a number of years, starting in the apparatus department, of which he was soon made manager.

WALTER M. FAGAN, whose appointment to the position of sales manager of the Hotpoint Division of the Edison Electric Appliance Co., Chicago, was noted in the Jan. 18 issue of ELECTRICAL REVIEW, is widely known in the electric range field, through his energetic work as sales manager of the

Walter M. Fagan.

Hughes Electric Heating Co. and in a similar capacity with the Hughes Division of the Edison Electric Appliance Co. He has an exceptional grasp of the sale of electric heating appliances, electric ranges and the utilization of electrical energy for heating and cooking purposes. Although a comparatively young man, Mr. Fagan has, particularly because of his keen aggressiveness, crammed into his short lifetime more than most men of his age. He was born on a ranch in Ventura county, California, in the year 1885, and held sales and executive positions with several large concerns. Among these was the Crouse-Hinds Co., whom he served prior to joining the Hughes organization in 1916.

H. R. PALMER, formerly general superintendent of the Virginia Railway & Power Co., serving Richmond, Norfolk, Petersburg, etc., has become general manager of the Harrisburg (Pa.) Light & Power Co., succeeding C. M. Kaltwasser, resigned. Mr. Palmer engaged in the public utility business in 1890 at Morristown, N. J., and in 1894 entered the employ of the Virginia company, with whom he has since been connected. Mr. Palmer is a graduate of the New York State Normal School.

FRELING FOSTER has secured his release from the Navy and has resumed his position on the merchandising staff of the Society for Electrical Development, New York City, from which he resigned last April to enlist.

FREDERICK P. ROYCE, Newton, Mass., for the past 10 years connected with the Stone & Webster Corporation, Boston, has been appointed general manager of the Brooklyn Rapid Transit Railway system. He was selected for this position by receiver Lindley M. Garrison.

CAPT. EDWARD E. ASHLEY, JR., for many years consulting mechanical and electrical engineer for Starrett & Van Vleck, architects, New York City, has received his honorable discharge from the Air Service of the United States Army, and has accepted an appointment as sales engineer of the Mercury Manufacturing Co., Chicago, manufacturer of electric industrial trucks.

A. H. KROM, formerly director of the Division of Engineering of the United States Employment Service, has been appointed assistant secretary of the American Association of Engineers at national headquarters, 29 South La Salle street, Chicago. Mr. Krom will devote about one-third of his time to the work of the Chicago chapter and the remainder of his time will be devoted to work in national headquarters.

HARRY O. SEYMOUR, for several years manager of the Wisconsin Telephone Co., of Milwaukee, Wis., resigned his position Feb. 1 to enter active duties as vice-president of the First National Bank of Milwaukee. Fifteen years ago Mr. Seymour entered the employ of the Wisconsin Telephone Co. as a collector and was advanced from time to time, becoming manager in 1913. He is well known to Milwaukee business men and has long taken an active part in club and civic work in his home city. He has also been elected a director of the First National Bank of Milwaukee.

C. G. HANDSEHY, assistant general manager of the Illinois Traction System, with headquarters at Springfield, Ill., will have charge of the new express company which is being organized by that system. Tariffs are being prepared for presentation to the Illinois Public Utilities Commission for approval. No express shipments have been handled over the Illinois Traction System since the American Railway Express time expired. Formerly the United States Express Co. and the Adams Express Co. operated over the 400 miles of the Illinois Traction System.

For the Readjustment Period—What?

XXIII.

THIS extract from an article by H. G. Moulton in The Chicago Daily News brings out facts in relation to raw material which, far from being discouraging, are an indication that one of the most severe handicaps to production for the American market will soon be removed.

C. A. TUPPER CHICAGO
President INTERNATIONAL TRADE PRESS, Inc.

Fallacies Exposed

It was the incorrigible assumption on the part of most business men and officials that there was to be an extraordinary demand for American materials abroad that was responsible for our failure to develop a reconstruction program in this country. With great prosperity certain and full employment of labor at high wages assured, demobilization could take care of itself. In the reported words of B. M. Baruch, chairman of the war industries board: "Reconstruction is largely a myth."

Subsequent events have already shown, however, that the demand for raw materials will fall far short of the war time needs. In nearly every line we are now overstocked with raw materials and we have an annual producing power in existing establishments much in excess of the prospective demands.

The basic fallacy in the argument that there would be an enormous postwar demand for raw materials is that need is assumed to be equivalent to effective demand—that is, to a demand that will yield a profit to the producer. Europe needs raw materials, just as a pauper needs food and clothing. But Europe has not the wherewithal to buy at American prices.

But can we not reduce the prices of American goods sufficiently to enable us to sell vast quantities abroad? It is urged that "abnormal" war prices must come down. Now, no one doubts that at a substantially lower price level we could sell—during the next year or two—a considerable volume of raw materials in Europe. But, owing to Europe's own necessity of large postwar production, European imports cannot possibly continue to equal more than a fraction of the total reached during the war period.

In considering the postwar trade with South America and the Orient it is necessary to reflect that we shall have to make price concessions there also. There is a limit to what the backward regions of the earth can afford to pay; and we may expect the spirit of business enterprise to prompt them to buy where they can obtain the most favorable terms. Let no one in his optimism over the future of our foreign trade underestimate the strength of British competition in the markets of the south and east. They are better prepared than we, in most respects, to enter these markets, and their necessity for capturing such trade is much greater than ours.

Financial News

Status of Public Utility Securities.

Public utility securities have been affected during the past four and one-half years of war by two outstanding factors —the lack of demand for investments other than government bonds, and the securities of industries which have greatly benefited under war conditions; and the decrease in net earnings of public utilities as a whole brought about by the abnormal costs of labor and materials.

The prices of all bonds of companies under Stone & Webster management have reflected a decrease in average price from 96.70 Aug. 1, 1914, to 86.90 Dec. 1, 1918; the price of all preferred stocks from 88.60 Aug. 1, 1914, to 66.20 Dec. 1, 1918.

Earnings of all public utility companies under Stone & Webster management have made the following showing:

	Gross		Net	
	Increase	Decrease	Increase	Decrease
1915 as compared with 1914		5.46%		7.65%
1916 as compared with 1915	8.95%		8.67%	
1917 as compared with 1916		13.36%		10.94%
1918 (10 mos.) as compared with 1917		19.45%		7.63%

With a return to peace conditions and a more normal demand for labor and materials, Stone & Webster believe that the prospects for the public utilities business are good. The securities of these companies are distinctly peace time investments and with an improvement in the general securities market, which is already evident, should prove to be selling at an exceptionally low level at present prices.

California Edison Bonds Offered.

The Harris Trust and Savings Bank, E. H. Rollin & Sons and the National City Co., all of Chicago, have purchased and are offering $8,000,000 Southern California Edison Co. general and refunding mortgage 25-year 6% gold bonds and $8,000,000 of the same company's 7% gold debenture bonds. The 6% bonds are due Feb. 1, 1944, and are being offered at 98 and interest, yielding 6.16%. The 7% debenture bonds are due $1,000,000 annually Jan. 15, 1921, to 1928, inclusive, and are being offered at par and interest. Both issues are said to be going well.

The Southern California Edison Co. supplies electric light and power to over 150 cities and towns in southern California, including Los Angeles, serving a population of over one million people. Both gross and net earnings have more than tripled during the last 12 years and net earnings for the year ended Nov. 30, 1918, were more than two and one-third times the annual mortgage bond interest charges.

Earnings as officially reported for the year ended Nov. 30, 1918, were as follows:

Gross earnings	$8,608,979
Operating expenses, including taxes, insurance and maintenance	3,309,419
Net earnings	5,308,559
Annual interest charges on outstanding mortgage bonds	2,240,840
Balance	3,067,719
Annual interest charge on $8,000,000 debenture bonds (this issue)	560,000
Surplus for depreciation and dividends	2,507,719

Orders B. R. T. $3,000,000 Loan.

The Federal District Court in New York City has authorized the receiver for the Brooklyn Rapid Transit Co. to borrow $3,000,000 immediately to meet the company's pressing financial needs. The court also appointed a special master to pass upon the $12,859,356 balance of receiver's certificates asked by that official.

The Brooklyn Edison Co. has sold to the Guaranty Trust Co. $5,500,000 general mortgage 5% series A bonds. Proceeds are to be used to reimburse the company for expenditures for additions and improvements.

New Jersey Public Service Votes Issue.

The directors of the Public Service Corporation of New Jersey have authorized $50,000,000 8% cumulative preferred stock. Shareholders are to be offered $12,500,000 collateral three-year 7% notes at 98½, convertible into preferred stock after Dec. 31, 1921, the proceeds to be used in part for paying off $7,500,000 notes maturing March 1 next.

Appeals for Valuation Reduction Filed.

The Public Service Corporation has filed 22 appeals with the Essex County Board of Taxation for reductions totaling $6,721,058.36 on valuations placed for assessment purposes on property of subsidiaries of the corporation. Twenty of the appeals are from valuations on property of the Public Service Electric Co. throughout the county, the other two being on holdings of the Public Service Railway Co., and the Public Service Railroad Co., the latter operating the fast line cars. In the case of the electric company's Newark assessment a reduction of $3,048,900 is requested, the city valuation being $5,833,800, against the company's appraisal of $2,784,900.

Mutualization of Ownership.

In view of the fact that the organization sold nearly $5,000,000 in securities to local customers of its public utilities all over the country, the following remarks of W. H. Clarke, manager of the bond department of H. M. Byllesby & Co., are of special interest: "The participation of local capital in the stock and bond issues of utilities has been growing rapidly, and as gas and electric companies further demonstrate their resourcefulness under all conditions, it may be expected that millions of people who have made their first purchases in public securities during the past two years will look to their local utilities as a safe and profitable medium for their investment funds. This mutualization of ownership or whatever term is applied to the practice of customers taking a financial interest in public service companies of all kinds, develops a true community interest and will have a tremendous effect in successfully thwarting what seem to be dangerous tendencies toward destructive socialism in this country."

Hughes on Public Ownership.

In commenting on a recent speech by Charles E. Hughes at Columbia University, the North American Review's War Weekly says:

"Regarding the respective merits of private and government ownership and operation of public utilities, Mr. Hughes but puts in words the result of all but universal experience when he says that such government ownership and operation mean inefficiency for one thing, and for another, the deadly danger to a Republic of vast bodies of organized political officeholders and job-holders. But government ownership is not the question which now concerns the country. It is not up for decision by the American people. What is before the people, and before them in ominously aggressive form, is whether the country shall be dragooned and tricked into a policy of government ownership without having an opportunity to say whether it wants it or not. It is that dragooning and chicanery process to which we are now being subjected. It is for the promotion of that government ownership policy in the interest of scheming politicians and socialist faddists that that temporary authority, granted under the impulse of generous patriotism, is now being exploited to ends never contemplated when it was granted."

WEEKLY COMPARISONS OF CLOSING-BID PRICES OF SECURITIES OF LEADING ELECTRICAL COMPANIES.

Quotations furnished by F. M. Zeiler & Co., Rookery Bldg., Chicago.

	Div. rate. Per cent.	Bid Jan. 28.	Bid Feb. 7.
Public Utilities—			
Adirondack Electric Power of Glens Falls, common	6	11	11
Adirondack Electric Power of Glens Falls, preferred	6	69	68
American Gas & Electric of New York, common	10+extra	98	98
American Gas & Electric of New York, preferred	6	43	43
American Light & Traction of New York, common	..	234	234
American Light & Traction of New York, preferred	6	98	98
American Power & Light of New York, common	4	55	56
American Power & Light of New York, preferred	6	75	75
American Public Utilities of Grand Rapids, common	..	..	..
American Public Utilities of Grand Rapids, preferred	7	35	35
American Telephone & Telegraph of New York	..	100½	99½
American Water Works & Elec. of New York, common	..	4	4
American Water Works & Elec. of New York, particip	7	10	10
American Water Works & Elec. of New York, first preferred	..	65	65
Appalachian Power, common	..	2	1
Appalachian Power, preferred	7	12	12
Cities Service of New York, common	+extra	296	312
Cities Service of New York, preferred	6	79½	80
Commonwealth Edison of Chicago	8	114	113½
Comm. Power, Railway & Light of Jackson, common	..	19	19
Comm. Power, Railway & Light of Jackson, preferred	6	41	40
Federal Light & Traction of New York, common	..	8	8
Federal Light & Traction of New York, preferred	..	39	39
Illinois Northern Utilities of Dixon	6	..	..
Middle West Utilities of Chicago, common	2+extra	20	20
Middle West Utilities of Chicago, preferred	6	50	50
Northern States Power of Chicago, common	..	62	62
Northern States Power of Chicago, preferred	ex.div.7	89	89
Pacific Gas & Electric of San Francisco, common	..	47	50
Pacific Gas & Electric of San Francisco, preferred	6	85	85
Public Service of Northern Illinois, Chicago, common	7	90	90
Public Service of Northern Illinois, Chicago, preferred	6	90	90
Republic Railway & Light of Youngstown, common	4	17	16½
Republic Railway & Light of Youngstown, preferred	6	51	52
Standard Gas & Electric of Chicago, common	..	13	13½
Standard Gas & Electric of Chicago, preferred	6	31	31
Tennessee Railway, Light & Power of Chattanooga, common	..	2	2½
Tennessee Railway, Light & Power of Chattanooga, preferred	6	13	13
United Light & Railways of Grand Rapids, common	4	37	36½
United Light & Railways of Grand Rapids, preferred	6	70	68
Western Power of San Francisco, common	..	17½	18½
Western Union Telegraph of New York	extra	86¼	86⅝
Industrials—			
Electric Storage of Philadelphia, common	4	52½	52½
General Electric of Schenectady	8	148	148
Westinghouse Electric & Mfg. of Pittsburgh, common	7	41	41
Westinghouse Electric & Mfg. of Pittsburgh, preferred	7	55	55